

RFP No. 614-002, Part B

Request for Proposal

Science West Renovation

Rockville Campus

VOLUME 1

**Montgomery College
Maryland**

**Date: February 28, 2014
Montgomery College
Office of Central Facilities
40 W. Gude Drive – Suite 200
Rockville, MD 20850**

**Science West Renovation
Rockville Campus**

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E201a	FIRST FLOOR LIGHTING PLAN – AREA A
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E203a	THIRD FLOOR LIGHTING PLAN – AREA A
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FA202A	PARTIAL SECOND FLOOR PLAN – NEW WORK – FIRE ALARM
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FA203A	PARTIAL THIRD FLOOR PLAN – NEW WORK – FIRE ALARM
FA203B	PARTIAL THIRD FLOOR PLAN – NEW WORK – FIRE ALARM
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ES202A	PARTIAL SECOND FLOOR PLAN – NEW WORK – SECURITY
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ES203B	PARTIAL THIRD FLOOR PLAN – NEW WORK – SECURITY
ES204A	PARTIAL ROOF PLAN – NEW WORK – SECURITY
ES204B	PARTIAL ROOF PLAN – NEW WORK – SECURITY
ES501	DETAIL SHEET – SECURITY
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TA203B	THIRD FLOOR TECHNOLOGY PLAN – AREA B
TA400	PARTIAL FLOOR PLAN – MDF DETAILS
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TA800	AV INFRASTRUCTURE DETAILS
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END OF LIST OF DRAWINGS



Procurement Office, Administrative Center
900 Hungerford Drive, Room 110
Rockville, Maryland 20850
Phone: (240) 567-5292

REQUEST FOR PROPOSAL

No. **614-002, Part B:
Interview and Price Proposal**

DATE ENTERED	BID CLASS	PAGE	of
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THIS IS NOT AN ORDER

MONTGOMERY COLLEGE
Germantown Campus

SCIENCE WEST RENOVATION
Rockville Campus

REQUEST FOR PROPOSAL
PART B: INTERVIEW AND PRICE PROPOSAL
RFP No. 614-002, Part B

Montgomery College is pleased to solicit Part B, Request for Proposal participation from the highest scoring Contractors selected under the Request for Proposal, Part A for the **Science West Renovation, Rockville Campus**.

This Request for Proposal forms Part B of the two part Proposal process. In Part B, selected Contractors are invited to participate in an interview, submit subcontractor information and a price proposal for the Project.

Proposal offers must remain valid for one hundred and fifty (150) days from the proposal due date. Upon contract award, prices must remain firm for the duration of the overall contract term.

Proposals must either be mailed or hand delivered to the Procurement Office (Room 110) of Montgomery College at 900 Hungerford Dr., Rockville, Maryland 20850 on or before the date and time defined below. Proposals will not be accepted if sent by facsimile or electronic mail or if received after the opening time and date specified. Contractor interviews will be scheduled following receipt of proposals.

All required submissions must accompany each proposal.

PART B PROPOSALS WILL BE ACCEPTED UNTIL THE CLOSING TIME OF 1:00 PM LOCAL TIME ON MAY 2, 2014.

The Part B proposal documents include the Request for Proposal, Part B; Instructions to Contractors, Part B; Supplementary Instructions to Contractors, Part B; Required Submissions, Part B; Information Available to Contractors, Part B; Price Proposal Form; Subcontractor's Qualification Statement; Subcontractor Information Form; Form of Contract; Bid Bond; Payment, Performance, Labor and Material Payment Bonds; General Conditions; Supplementary Conditions; Technical Specifications and Drawings and all Addenda.

An informational meeting will be held on **April 10, 2014 at 2:00 PM** in Room 224 in the Gudelsky Institute for Technical Education, Rockville Campus, Rockville, MD 20850. Attendance by Contractors is strongly encouraged. A site inspection opportunity will be provided following the meeting. Site examination is mandatory and verification of the examination by a College representative is required.

Complete Part B proposal documents may be purchased from ABC Imaging, 1155 21st Street, NW, Suite M400, Washington, DC 20036, attn: Mike McCauley, tel: 202-429-8870, fax: 202-429-91336, on or after **April 7, 2014**.

Complete Part B proposal documents can be examined, at no charge, by appointment, on or after **April 7, 2014** at Montgomery College, Office of Central Facilities, 40 West Gude Drive, Suite 200, Rockville, MD 20850, attn: Peter Hanley, tel: 240-567-5319.

Complete Part B proposal documents may be obtained by downloading electronic (PDF) files, on or after **April 7, 2014**, as directed by the College's Office of Procurement at no charge.

Proposals will be reviewed by a College Evaluation Committee who will assess the substantiated ability of the Contractor to perform the required construction services described in the proposal documents and the Contractor's responsiveness to Part A Qualification Proposal, Part B Interview, Subcontractor Information and Price Proposal requirements. The Contractor achieving the highest combined score of Part A and Part B will be recommended for contract award.

All procurement questions shall be directed, in writing, no later than **5:00 PM April 17, 2014**, to Yu (Judy) Zhu, Purchasing Manager, Office of Procurement, Montgomery College, Fax: 240-567-6397 E-mail: yu.zhu@montgomerycollege.edu. Only answers provided via a written addendum issued by the College will be binding.

All technical questions shall be directed, in writing, no later than **5:00 PM April 17, 2014**, to Kevin Redinger, Acting Director of Project Management, Office of Central Facilities, Montgomery College, Fax: 240-567-7379 E-mail: kevin.redinger@montgomerycollege.edu. Only answers provided via a written addendum issued by the College will be binding.

BID AND PERFORMANCE SECURITY REQUIREMENTS APPLY AS FOLLOWS: 5% BID BOND & 100% PERFORMANCE AND 100% LABOR AND MATERIAL PAYMENT BONDS; PUBLIC UTILITY BONDS AS SPECIFIED IN THE CONTRACT DOCUMENTS.

STATE OF MARYLAND PREVAILING WAGE RATES REQUIREMENTS AND REPORTING PROCEDURES, STATE APPRENTICESHIP AND TRAINING FUND LAW WILL APPLY TO THIS PROJECT.

MINORITY VENDOR PARTICIPATION IS ENCOURAGED IN THIS SOLICITATION.

NO ALLOWANCES SHALL BE MADE TO THE SUCCESSFUL CONTRACTOR, AT A LATER DATE, FOR ADDITIONAL WORK REQUIRED BECAUSE OF CONTRACTOR'S FAILURE TO INSPECT THE PROJECT SITE.

IMPORTANT: YOUR PROPOSAL WILL BE JEOPARDIZED IF ANY PORTION OF THIS INQUIRY IS NOT COMPLETE. NO PROPOSAL WILL BE ACCEPTED AFTER THE DATE AND TIME STATED ABOVE.

Patrick L. Johnson, CPPB
Director of Procurement

CONDITIONS AND INSTRUCTIONS

1. ADDITIONAL ORDERS: Unless it is specifically stated to the contrary in the bid response, the College reserves the option to place additional orders against a contract awarded as a result of this solicitation at the same terms and conditions, if it is mutually agreeable.

2. APPLICABLE LAW: This contract shall be construed and interpreted according to Maryland law.

3. ASSURANCE OF NON-CONVICTION OF BRIBERY: The bidder hereby declares and affirms that, to its best knowledge, none of its officers, directors or partners and none of its employees directly involved in obtaining contracts has been convicted of bribery, attempted bribery or conspiracy to bribe under the laws of any state or the Federal government.

4. AUDIT: Bidder shall permit audit and fiscal and programmatic monitoring of the work performed under any contract issued from this solicitation. The College shall have access to and the right to examine and/or audit any records, books, documents and papers of bidder and any subcontractor involving transactions related to this Agreement during the term of this Agreement and for a period of three (3) years after final payment under this Agreement.

5. AWARD CONSIDERATIONS: Awards of this bid will be made to the lowest responsible bidder conforming to specifications with consideration being given to quantities involved, time required for delivery, purpose for which required, responsibility of bidder and its ability to perform satisfactorily with consideration to any previous performance for Montgomery Community College. A bid may be awarded at the sole discretion of the College in the best interest of the College. Prompt payment discounts will not be considered in bid evaluation. All discounts other than prompt payment are to be included in bid price.

6. BID AND PERFORMANCE SECURITY: If bid security is required, a bid bond or cashier's check in the amount indicated on the bid cover must accompany each bid and be made payable to Montgomery Community College. Corporate or certified checks are not acceptable. Bonds must be in a form satisfactory to the College and underwritten by a company licensed to issue bonds in the State of Maryland. If bid security fails to accompany the bid, it shall be deemed unresponsive, unless the Director of Procurement deems the failure to be nonsubstantial. Such bid bonds or checks will be returned to all except the three (3) lowest bidders within five (5) days after the opening of bids, and the remaining checks or bid bonds will be returned to all but successful bidder(s) within forty-eight (48) hours after award of contract. If a performance bond is required, the successful bidder must submit an acceptable performance bond in the designated amount of the bid award, prior to award of contract. All bid bonds will be returned to the successful bidder(s) within fortyeight (48) hours after receipt of the performance bond.

7. BRAND NAMES: Brand name materials used in these specifications are known and acceptable. Bids including proposals to use alternate brands are invited as long as they are of equal type and equal or better quality. The burden of proof that alternate brands are in fact equal or better falls on the bidder, and proof must be to the College's satisfaction.

8. COMPLIANCE WITH LAWS: Bidder agrees to comply, at no additional expense, with all applicable Executive orders, Federal, State, bi-county, regional and local laws, ordinances, rules and regulations in effect as of the date of this Agreement and as they may be amended from time to time, including but not limited to the equal employment opportunity clause set forth in 41 CFR 60-250.4.

9. CONTINGENT FEES: Bidder hereby declares and affirms that neither it nor any of its representatives has employed or retained any person, partnership, corporation, or other entity, other than a bona fide employee or agent working for the bidder, to solicit or secure a contract, and that it has not paid or agreed to pay any person, partnership, corporation, or other entity, other than a bona fide employee or agent, any fee or any other consideration contingent on the making of a contract as a result of this solicitation.

10. DELIVERY AND PACKING: All prices quoted must include delivery. All goods delivered under this contract shall be packed in accordance with accepted trade practices. No charges may be made over and above the bid price for packaging, or for deposits or containers unless specified in the bid. No charge will be allowed for cartage unless by prior written agreement. Complete deliveries must be made by the successful bidder to the designated location as indicated on the Montgomery Community College purchase order. A packing slip shall be included in each shipment. All deliveries must be prepaid and must be delivered to each location designated on purchase order at no additional cost. DELIVERIES MUST BE MADE TO THE SPECIFIED LOCATION. NO COLLECT SHIPMENTS OR SIDEWALK DELIVERIES WILL BE ACCEPTED.

11. DELIVERY OF BIDS: Sealed bids must be received in the Procurement Office by the date and time specified in the bid in order to be considered. NO LATE BIDS OR PROPOSALS WILL BE ACCEPTED. Late bids will be returned to the bidder unopened. Bids submitted by mail must be addressed to the Procurement Office, Montgomery College, P.O. Box 1006, Rockville, Maryland 20850, and clearly marked to indicate the bid number, title and opening date. Hand delivered bids will be accepted only at the Procurement Office, Montgomery College Central Administrative Center, Room 110, 900 Hungerford Drive, Rockville, Maryland 20850.

12. DISPUTES: Any dispute arising under a contract awarded as a result of this bid which is not disposed of by agreement shall be decided by the President of the College or designee. Pending the final decision of the dispute, contractor shall proceed with the contract performance. Nothing hereunder shall be interpreted to preclude the parties from seeking after completion of the contract any and all remedies provided by law.

13. ERRORS IN BIDS: Bidders are assumed to be informed regarding conditions, requirements, and specifications prior to submitting bids. Failure to do so will be at the bidder's risk. Bids already submitted may be withdrawn without penalty prior to bid opening. Errors discovered after bid opening may not be corrected. In the case of an error in price extension, the unit price will govern. The intention of the bidder must be evident on the face of the bid.

14. HAZARDOUS AND TOXIC SUBSTANCES: Bidder must comply with all applicable Federal, State, County and bi-county laws, ordinances and regulations relating to hazardous and toxic substances, including such laws, ordinances and regulations pertaining to access to information about hazardous and toxic substances, and as amended from time to time. Bidder shall provide the College with a "Material Safety Data Sheet" or in the case of a controlled hazardous waste substance, a hazardous waste manifest for all hazardous chemicals listed or subsequently added to the Chemical Information List in compliance with applicable laws, ordinances and regulations.

15. INSPECTION OF PREMISES: If a site visit is recommended or required, each bidder is responsible to visit the site(s) prior to submitting a bid in order to observe the existing conditions affecting the work, and to obtain precise dimensions of the area(s) involved. No allowance will be made to the successful bidder, at a later date, for additional work required because of his or her failure to visit the site and/or to obtain the exact dimensions. Discrepancies, if any, must be reported to the College.

16. INSURANCE: If a contract results from this bid, the contractor shall maintain such insurance as will indemnify and hold harmless the College from Workmen's Compensation and Public Liability claims for property damage and personal injury, including death, which may arise from the contractor's operations under this contract, or by anyone directly or indirectly employed by him/her.

17. MARYLAND PUBLIC INFORMATION ACT: Bidder recognizes that the College is subject to the Maryland Public Information Act, Title 10 of the State Government Article of the Annotated Code of Maryland. Bidder agrees that it will provide any justification as to why any material, in whole or in part, is deemed to be confidential, proprietary information or trade secrets and provide any justification of why such materials should not be disclosed pursuant to the Maryland Public Information Act.

18. NON-ASSIGNMENT AND SUBCONTRACTING: Bidder shall not assign any contract or any rights or obligations hereunder without obtaining prior written consent of the College. No contract shall be made by bidder with any other party for furnishing the services to be performed under a contract issued from this solicitation without the written approval of the College. These provisions will not be taken as requiring the approval of the contract of employment between bidder and its personnel.

19. NON-COLLUSION: Bidder certifies that it has neither agreed, conspired, connived, or colluded to produce a deceptive show of competition in the compilation of the bid or offer being submitted herewith; bidder also certifies that it has not in any manner, directly or indirectly, entered into any agreement, participated in any collusion to fix the bid price or price proposal of the bidder or offeror herein or any competitor, or otherwise taken any action in restraint of free competitive bidding in connection with the contract for which the within bid or offer is submitted.

20. NON-DISCRIMINATION: Bidder assures the College that, in accordance with applicable law, it does not,

and agrees that it will not discriminate in any manner on the basis of sex, race, age, color, creed, national origin, religious belief, handicap, marital status, or status as a disabled veteran or veteran of the Vietnam era. Bidder further agrees to post in conspicuous places notices setting forth the provisions of the nondiscrimination clause and to take affirmative action to implement the provisions of this section. Bidder further assures the College that, in accordance with the Immigration Reform and Control Act of 1986, it does not and will not discriminate against an individual with respect to hiring, or recruitment or referral for a fee, of the individual for employment or the discharging of the individual from employment because of such individual's national origin or in the case of a citizen or intending citizen, because of such individual's citizenship status.

21. PATENTS: Bidder guarantees that the sale and/or use of the goods offered will not infringe upon any U.S. or foreign patent. Bidder will at his/her own expense, indemnify, protect and save harmless the College, its trustees, employees, agents and students with respect to any claim, action, cost or judgment for patent infringement, arising out of the purchase or use of these goods.

22. PREPARATION OF BID: Bids submitted must be hand signed by an authorized agent of the company submitting the bid. Notification of award will be made by "Notice of Intent to Award" and/or purchase order. A bidder may attach a letter of explanation to the bid for clarification. Bidders will be required, if requested by Montgomery Community College, to furnish satisfactory evidence that they are, in fact, bona fide manufacturers of or dealers in the items listed, and have a regularly established place of business. The College reserves the right to inspect any bidder's place of business prior to award of contract to determine bidder responsibility.

23. PRODUCT TESTING DURING TERM OF CONTRACT: Goods delivered under any contract resulting from this Request for Bid may be tested for compliance with specifications stipulated herein. Any shipment failing to meet or comply fully with the specification requirements will be rejected. The cost of testing a representative sample of an order or shipment for acceptance shall be borne by the College unless the order is rejected for failure to meet specifications or purchase description. In such cases of rejection, the cost of testing will be charged back to the vendor.

24. RECORD RETENTION: If awarded a contract, vendor shall maintain books and records relating to the subject matter of this Agreement, including but not limited to all charges to the College, for a period of three (3) years from the date of final payment under this Agreement.

25. REJECTIONS AND CANCELLATIONS: Montgomery Community College reserves the right to accept or reject any or all bids in whole or in part for any reason. The College reserves the right to waive any informalities and to make awards in the best interest of the College. The College also reserves the right to reject the bid of any bidder who has previously failed to perform adequately on a prior award for furnishing goods and/or services similar in nature to those requested in this bid. The College may cancel this solicitation in whole or in part, in its sole discretion.

26. RIDER PROVISION FOR MONTGOMERY COUNTY PUBLIC SCHOOLS AND MONTGOMERY

COUNTY: The bidder agrees when submitting the bid that it will make available to every office and department of the Montgomery County Public Schools and the Montgomery County Government the same bid prices, terms and conditions offered during the term of contract. Orders will be placed directly by these agencies. There will be no penalty if bidder notes exception to this provision in the bid offered.

27. SAMPLES AND CATALOG CUTS: If samples are required, bidder shall be responsible for delivery of samples to location indicated. All sample packages shall be marked "Sample for Procurement Office, Bid No. ____" and each sample shall be tagged or marked. Failure of the bidder to clearly identify samples as indicated may result in rejection of bid. The College reserves the right to test any materials, equipment or supplies delivered to determine if the specifications have been met. Samples will not be returned.

28. SIGNATURE: Each bid must show the full business address and telephone number of the bidder and be signed by the person or persons legally authorized to sign such contracts. All correspondence concerning the bid and contract, including the bid summary, copy of contract, and purchase order, will be mailed or delivered to the address shown on the bid. NO BID WILL BE ACCEPTED WITHOUT ORIGINAL SIGNATURE.

29. TAXES: The College is exempt from Federal and Maryland taxes. Exemption Certificates are available upon request. Bidder shall be responsible for the payment of any and all applicable taxes resulting from any award and/or any activities hereunder, including but not limited to any applicable amusement and/or sales taxes.

30. TERMINATION BASED ON LACK OF FUNDING: Any contract awarded as a result of this solicitation will be subject to funding and continued appropriation of sufficient funds for the contract. For purposes of this solicitation, the College's appropriating authority is deemed to be the Board of Trustees of Montgomery Community College. Insufficient funds shall be grounds for immediate termination of this solicitation.

31. TERMINATION FOR DEFAULT: If an award results from this bid, and the contractor has not performed or has unsatisfactorily performed the contract, payment shall be withheld at the discretion of the College. Failure on the part of the contractor to fulfill contractual obligations shall be considered just cause for termination of the contract and the contractor is not entitled to recover any costs incurred by the contractor up to the date of termination.

CONDITIONS AND INSTRUCTIONS

32. TERMINATION FOR THE CONVENIENCE OF THE COLLEGE: The performance of the work or services under a contract as a result of this solicitation may be terminated in whole or in part, whenever the President of Montgomery Community College shall deem that termination is in the best interest of the College. Such determination shall be in the sole discretion of the President. In such event, the College shall be liable only for payment in accordance with the payment provisions of the contract for work or services performed or furnished prior to the effective date of termination. Termination hereunder shall become effective by delivery to contractor of written notice of termination upon which date the termination shall become effective.

33. WARRANTY: Bidder expressly warrants that all articles, material and work offered shall conform to each and every specification, drawing, sample or other description which is furnished to or adopted by the College and that they will be fit and sufficient for the purpose intended, merchantable, of good material and workmanship, and free from defect. Such warranty shall survive a contract and shall not be deemed waived either by the College's acceptance of said materials or goods, in whole or in part, or by payment for them, in whole or in part. The bidder further warrants all articles, material and work performed for a period of one year, unless otherwise stated, from date of acceptance of the items delivered and installed, or work completed. All repairs, replacements or adjustments during the warranty period shall be at bidder's sole expense.

INSTRUCTIONS TO CONTRACTORS, PART B

Science West Renovation Rockville Campus

PART 1 – PROPOSAL AND AWARD SCHEDULE

1.1 It is the College's intent to administer Part B of the Request for Proposal process for this project according to the schedule dates outlined below. The College reserves the right to alter schedule dates as may be determined necessary in the College's best interests.

1.2 **Part B: Interview and Price Proposal**

April 7, 2014	RFP Part B Documents available
April 10, 2014	Informational Meeting
April 17, 2014	Last Requests for Information due
May 2, 2014	Price Proposal and Subcontractor Information Due by 1:00 PM
May 6, 2014 - May 7, 2014	Contractor Interviews
May 8, 2014 – June 23, 2014	Price Proposals opened and apparent highest cumulative scoring contractor identified. Reference checks completed.
June 23, 2014	Approval of Recommendation of Contract Award by College Board of Trustees

1.3 It is the College's intent to seek approval of award of this contract to the Evaluation Committee's recommended highest scoring Contractor at the June 2014 meeting of the College Board of Trustees, and subject to approval by the Board of Trustees; to seek concurring approval of contract award from the State of Maryland promptly thereafter.

Notwithstanding these expectations, the College may require additional time to administer the contract award or other processes; therefore, proposal submissions and prices must remain valid for one hundred and fifty (150) days from the proposal due date. Anticipated Contract Award date, Notice to Proceed date or other project scheduling expectations may be adjusted in concert with this provision. It is the Contractor's sole responsibility to ensure that the proposal response accommodates this requirement.

PART 2 - INFORMATIONAL MEETING

- 2.1 An informational meeting will be held on **April 10, 2014 at 2:00 PM** in Room 224 of the Gudelsky Institute for Technical Education on the Rockville Campus, , Rockville, MD 20850. Attendance by the selected Contractors is strongly encouraged, but is not required.

PART 3 - PROPOSAL DOCUMENTS

- 3.1 The Part B proposal documents include the Request for Proposal, Part B; Instructions to Contractors, Part B; Supplementary Instructions to Contractors, Part B; Required Submissions, Part B; Information Available to Contractors, Part B; Price Proposal Form; Bid Bond; Verification of Examination of Site Conditions; Subcontractor's Qualification Statement; Form of Contract; Payment, Performance, Labor and Material Bonds; General Conditions; Supplementary Conditions; Technical Specifications and Drawings and all Addenda.

- 3.2 Complete Part B proposal documents may be purchased by the selected contractors on or after **April 7, 2014** from:

ABC Imaging
1155 21st Street, NW – Suite M400
Washington, DC 20036

Attn: Mike McCauley
Phone: 202-429-8870
Fax: 202-429-9136

Only complete, hard-copy sets of proposal documents may be purchased.

- 3.3 Complete Part B proposal documents will be available for reference, by appointment, on or after **April 7, 2014** at:

Montgomery College
Office of Central Facilities
40 West Gude Drive, Suite 200
Rockville, Maryland 20850

Attn: Peter Hanley, Senior Project Manager
Phone: 240-567-5391

- 3.4 Complete Part B proposal documents will be distributed in electronic (PDF) file format to the selected Contractors by College Procurement Office on or after April 7, 2014.
- 3.5 Montgomery College is not responsible for content of and/or information obtained from sources not listed in the Request for Proposal. Only information obtained from College Procurement Office, on its website, or from sources listed in the Request for Proposal should be considered reliable. It is the Contractor's sole responsibility to assure that accurate information has been used in preparation of the proposal response.

- 3.6 Proposal submission shall serve as verification that, at the time of receipt of the proposal, the Contractor has inspected, has read and is thoroughly familiar with the proposal documents (including all Addenda); has examined and finds the Specifications and the Drawings adequate information on which to base the proposal response. Failure or omission of a Contractor to inspect the site or to examine any form, instrument or document shall in no way relieve a Contractor from obligations with respect to the proposal response.

PART 4 - SITE EXAMINATION

- 4.1 Examining and investigating existing site conditions prior to proposal submission is a mandatory requirement of Request for Proposal Part B. Contractors are required to include Verification of Examination of Site Conditions Form (Section 004400) signed **by** a College representative in with the Price Proposal submission.

A site inspection opportunity will be provided immediately following the informational meeting.

Access to the site and/or College records may be obtained by contacting:

Peter Hanley, Senior Project Manager
Phone: 240-567-5391

- 4.2 Data in the proposal documents pertaining to existing conditions is for convenience only and does not supplant obtaining first-hand information at the site.
- 4.3 Proposal submission shall serve as verification that, at the time of receipt of the proposal, the Contractor has inspected and is thoroughly familiar with the site and has found adequate information on which to base the proposal response. Failure or omission of a Contractor to inspect the site or to examine any form, instrument or document shall in no way relieve a Contractor from obligations with respect to the proposal response.

PART 5 - INTERPRETATION OR CORRECTION OF PROPOSAL DOCUMENTS

- 5.1 The proposal documents should be examined carefully. Prior to submitting its price, should the Contractor find discrepancies or omissions in the documents, have questions regarding the intent of the documents or be in doubt as to the meaning of any item(s), or require clarification of any conflict between two or more items contained within the documents, a written request for clarification should be submitted to the College.
- 5.2 Should the Contractor fail to obtain clarification, then the College is entitled to direct that the Work proceed in accord with the better quality and greater quantity of any method indicated, specified or required by the documents, in the judgment of the College. Such direction by the College shall not constitute the basis for a claim for extra costs by the Contractor. The Contractor acknowledges that it had the opportunity to request clarification prior to submitting its price to the College and that it is not entitled to claim extra costs as a result of failure to request such clarification.

- 5.3 Contractors shall be responsible for reviewing and coordinating the submission of clarifications requested by Subcontractors or Vendors. Clarification requests made directly by Subcontractors or Vendors will not be accepted by the College.
- 5.4 Written requests for clarification should be submitted to:
Kevin Redinger, Acting Director of Project Management
Fax: 240-567-7379
E-mail: kevin.redinger@montgomerycollege.edu
- 5.5 Contractors shall not communicate directly with any Architect/Engineer or any of the Architect/Engineer's consultants.
- 5.6 REQUESTS FOR CLARIFICATIONS FROM CONTRACTORS MUST BE SUBMITTED IN WRITING NO LATER THAN **5:00 PM ON April 17, 2014**.
- 5.7 No interpretation of the meaning of the proposal documents will be made to any Contractor orally as oral instruments do not form a part of the proposal documents.
- 5.8 The College will review the written requests for clarification, and any interpretations and supplemental instructions will be provided in the form of written Addenda to the proposal documents which, if issued, will be furnished electronically, with delivery confirmation recorded, to the selected Contractors by College Procurement Office.

All Addenda shall become part of the proposal documents.

It is the Contractor's sole responsibility to ensure receipt of all Addenda. It is strongly recommended that the Contractor check with College Procurement Office for all Addenda prior to submitting a proposal. Failure of any Contractor to receive Addenda shall not relieve the Contractor from any obligation with respect to the proposal.

PART 6 - PREPARATION AND SUBMITTAL OF PROPOSALS

- 6.1 This part of the Request for Proposal includes requirements for **Price Proposals** and for prospective **Subcontractor Information**.
- 6.2 Proposal submittals shall be divided into **two separately sealed packages**, one containing the **Price Proposal** submission and the second containing the **Subcontractor Information** submission.
- 6.3 An **original and two copies** of the **Price Proposal** submission are required. The cover page of each copy should be clearly marked "original" or "copy" accordingly.
- 6.4 An **original and four copies** of the **Subcontractor Information** submission are required. The cover page of each copy should be clearly marked "original" or "copy" accordingly.
- 6.5 Price Proposals must include the enclosed Price Proposal Form and must include all the attachments or statements requested in the proposal documents.
- 6.6 Subcontractor Information must include the enclosed Subcontractor Information Form for each prospective Key Principal Subcontractor for which information is requested.

- 6.7 Price Proposal and Subcontractor Information submissions shall be typewritten, printed or clearly written in ink, and organized behind tabs that correspond with each required section.
- 6.8 On the Price Proposal Form, all blank spaces for proposed prices must be filled in, in figures and words where required. The words "No Price" in any of the spaces constituting a proposed price response and/or any qualification to the proposal price may cause the entire proposal to be rejected.
- 6.9 The Price Proposal Form shall be signed in longhand below the typed name of the person authorized to bind the Contractor to a contract.

When Contractor is a corporation, the proposal must be signed with the legal name of the corporation followed by the name of the State of incorporation and the legal signature of a person authorized to bind the corporation to a contract.

Any erasures on or changes to the forms must be initialed by the person signing the proposal.

- 6.10 Price Proposal submissions must be submitted in a sealed envelope or box. Subcontractor Information submission must be submitted in a separate sealed envelope or box. Contractors must duplicate and paste the following submission labels on the outside of the sealed envelope or box. It is mandatory that the submission labels be used. Failure to do so may cause the proposal to be rejected.

PRICE PROPOSAL SUBMISSION

RFP No.: 614-002, Part B: Interview, Sub-Contractor Information and Price Proposal

Proposal Due Date: by May 2, 2014

Proposal Due Time: by 1:00 PM

Contractor's Name: _____

Contractor's Address: _____

**Project Title: Science West Renovation
Rockville Campus**

SUBCONTRACTOR INFORMATION SUBMISSION

RFP No.: 614-002, Part B: Interview, Sub-Contractor Information and Price Proposal

Proposal Due Date: by May 2, 2014

Proposal Due Time: by 1:00 PM

Contractor's Name: _____

Contractor's Address: _____

**Project Title: Science West Renovation
Rockville Campus**

- 6.11 Any proposal or information received after the time and date specified, or at a different location than specified above, will not be opened or given any consideration.

PART 7 - ERRORS IN PROPOSALS

- 7.1 The College assumes that Contractors are fully informed regarding conditions and requirements of the project site and the proposal documents prior to submitting proposal responses. Contractors are responsible for seeking proper information and making the necessary investigations. Failure to do so is at the Contractor's sole risk.

Proposal responses may be withdrawn without penalty prior to proposal receipt due date and time. Errors discovered after proposal receipt due date and time may not be corrected.

PART 8 - DELAYED OPENING

- 8.1 If Montgomery College is closed for any reason on the day proposals are due, the proposal shall be submitted on the next business day the College is open, at the same stated submission time, unless other direction is provided.

PART 9 - WITHDRAWAL OF PROPOSALS

- 9.1 Contractor may not withdraw or modify the proposal submittal for one hundred and fifty (150) calendar days after the proposal due date and time because the College may require additional time to administer College, County and/or State contract award or other regulatory processes.

To accommodate this administrative requirement, proposal submissions and prices must remain valid for one hundred and fifty (150) days from the proposal due date. Anticipated Contract Award date, Notice to Proceed date and project scheduling expectations may be adjusted in concert with this provision. It is the Contractor's sole responsibility to ensure that the Proposal response accommodates this requirement.

PART 10 - EVALUATION OF PROPOSALS, PART B

- 10.1 In Part B, Selected Contractors are invited to attend an Interview, submit Key Subcontractor Information and a Price Proposal.

- 10.2 Contactor Interview (20% of total score)

Interviews will be conducted by the College Evaluation Committee who will ask each Contractor the same set of pre-determined questions. The questions will not be provided to the Contractors in advance.

The interview will be scheduled for 1 ½ hours in duration, with 15 minutes allocated to personal introductions (no prepared presentation will be permitted); 60 minutes allocated to the specific pre-determined questions, and; 15 minutes allocated to Contractor's concluding remarks. Contractors are not expected to prepare a detailed presentation.

Through the interview, the College expects to learn more about the relevance of the Contractor's and its team members' past project experience with respect to the Science West Renovation scope of work, as well as to understand more completely the Contractor's plans for achieving high quality results for the benefit of the College. Information collected prior to the interview in the Part A, Qualification Proposal and Part B, Subcontractor Information submissions may be referenced during the interview.

Evaluation of the Contractor's responsiveness in the following areas of inquiry should be expected:

- A. Experience on projects of comparable size, scope and complexity
 - 1) Contractors are advised to include active participation of all key management personnel proposed.
 - 2) Contractors are required to submit a list of up to three key principle subcontractors under consideration for each of the following trades in RFP Part B Proposal submission:
 - a. Curtainwall
 - b. HVAC/Plumbing
 - c. Electrical

Participation by key principal subcontractors is not expected during the interview.

- B. Clarity and effectiveness of proposed project coordination effort.
- C. Clarity and effectiveness of proposed Quality Control program.
- D. Effectiveness at addressing unique project constraints/concerns.

10.3 Price Proposal (50% of total score)

The Contractor's Price Proposal with the lowest responsive and responsible Base Bid Price will be awarded the highest point score.

Higher proposal prices will be awarded reduced point scores, determined by ratio comparing the proposed price to the lowest responsive and responsible proposal price.

PART 11 - COLLEGE'S RIGHTS

- 11.1 The College reserves the following rights to be exercised at the College's sole discretion:
 - A. To reject any or all proposals and to make awards in the best interest of the College, in the name of the Board of Trustees. The College also reserves the right to cancel the Request for Proposals.
 - B. To make such investigation as deemed necessary to determine the qualifications of the Contractor and to determine the ability of the Contractor to perform the work. The Contractor shall furnish to the College all such information and data as the College may request.

The College reserves the right to reject any proposal if the evidence submitted by, or investigation of, the Contractor fails to satisfy the College that the Contractor is properly qualified to carry out the obligations of the contract and to complete the work contemplated.

- C. Conditional proposals will not be accepted.
- D. To consider informal, any proposal not prepared or submitted in accordance with the provisions hereof. The College may at its sole discretion waive any informality. A waiver of any provision of the proposal documents shall not constitute a waiver of any subsequent breach.

PART 12 - AWARD CONSIDERATIONS

- 12.1 The Contractor achieving the highest combined score of Part A and Part B evaluation will be recommended for contract award to the College's Board of Trustees and; contingent on Board of Trustee's approval, the contract award recommendation will be referred to the State of Maryland for concurring approval.

END OF INSTRUCTIONS TO CONTRACTORS, PART B

SUPPLEMENTARY INSTRUCTIONS, PART B**Science West Renovation
Rockville Campus****PART 1 – PRELIMINARY SCHEDULE**

1.1 Preliminary schedule instructions apply to the project as follows:

- A. The College offers classes during traditional Fall and Spring academic semesters, as well as during a winter intersession and two summer session periods. Contractor is reminded that they may be asked to refrain from noisy work during the associated testing periods when tests are scheduled in adjoining buildings. Specific calendars and constraints will be provided by the College when available. Calendars are subject to adjustment in the event that inclement weather, or other cause, closes the College.
- B. The College anticipates that the building will be complete and ready for coordination of the following milestone activities administered by the College, concurrent with Contractor's completion of the project as follows:
 - 1) OIT Infrastructure Installation: 4 months prior to Final Completion
 - 2) Owner furnished FFE Delivery and Installation: 4 months prior to Final Completion
 - 3) OIT Equipment Installation: 3 months prior to final Completion
- C. The College anticipates Substantial Completion and Occupancy, related milestones and Final Completion as follows:
 - 1) Substantial Completion including issuance of Use and Occupancy Permit: 2 months prior to Final Completion
 - 2) Final Cleaning Completion: At Substantial Completion
 - 3) Faculty and staff move –in: 1 month prior to Final Completion
 - 4) Final Completion (building able to open for classes): not more than 24 months following Notice to Proceed

PART 2 – NOT USED

PART 3 - NOT USED

PART 4 – MINORITY PARTICIPATION

- 4.1 Pursuant to Board Resolutions #87-82 and #87-83, adopted on July 20, 1987, it is the policy of Montgomery College to encourage minority businesses to provide goods and services for the performance of College functions. Minority businesses include non-profit entities organized to promote the interests of handicapped persons, and firms that are 51% owned and controlled by a member(s) of socially or economically disadvantaged minority group, which includes: African American, American Indian/Native American, Asian, Hispanic, women, and physically or mentally disabled.
- 4.2 The Contractor must submit an updated College's Minority Participation Form, included in the proposal documents, with the Price Proposal.
- 4.3 If the Contractor is not a minority business entity, the Contractor is encouraged to develop a plan that, at a minimum, will award 15% of the total contract value to subcontractors and/or vendors that are minority businesses.
- 4.4 Non-minority Contractors are advised that following contract award, within three business days of request by the College, the Contractor shall provide a list indicating minority subcontractor and/or vendor participation anticipated for the project. The Contractor shall provide the College with routine updates should any changes in subcontractor or vendor status occur during the contract term.

PART 5 - BONDS

- 5.1 With the Price Proposal, Contractor shall furnish a Bid Bond and a Letter of Intent from a Bonding Company as required below.
- 5.2 Contractor shall submit an **original** and **two** copies of a Bid Bond from a surety company authorized to do business in the State of Maryland, acceptable to the College, made payable without condition to the College, for not less than 5% of the amount of the Base Price Total, or a cashier's check in the amount of not less than 5% of the Base Price Total. Bid Bond shall be prepared and submitted on AIA Form A310-2010, "BID BOND".
- 5.3 Contractor shall submit an **original** and **two** copies of a letter from the Contractor's bonding company stating that it guarantees it will furnish the required 100% performance and labor and material payment bonds if the Contractor is recommended for contract award. Letter provided shall not be generic, but must be written specifically for this project.
- 5.4 Prior to the execution of the contract, the Contractor shall deliver to the College a performance bond, properly executed on the Montgomery College Standard Performance Bond a copy of which is enclosed in the Proposal Documents, and a labor and material payment bond executed on AIA Document A312-2010, Payment Bond, for 100% of the amount of the Contract.
- 5.5 Upon failure or refusal to execute and deliver the Contract and bonds required within five (5) days (Saturdays, Sundays and legal holidays excluded) after having received notice of acceptance of its proposal, the Contractor shall forfeit to the College, as liquidated damages for such failure or refusal, the bid security included with its proposal.

- 5.6 After the College and the successful Contractor have executed a contract, or if no contract has been executed within one hundred and fifty (150) calendar days after the proposal due date, and Contractor has not been notified of acceptance of its proposal, Contractor may request return of its Bid Bond.
- 5.7 If at any time, the Bonding Company becomes insolvent, files for bankruptcy or for any reason whatsoever loses its right to do business in the State of Maryland, the Contractor shall, within ten (10) calendar days after notice from the College to do so, substitute an acceptable Bond (or bonds) in such form and sum and signed by such other Bonding Company as may be satisfactory to the College.
- 5.8 Attorneys-in-fact who sign bid bonds or contract bonds must file with each bond, a certified and effectively dated copy of their power of attorney.

PART 6 - INSURANCE

- 6.1 Contractors are advised that before starting any work, the successful Contractor must provide sufficient evidence of insurance showing adequate coverage as defined in the proposal documents.

PART 7 - FORM OF CONTRACT

- 7.1 Contractors are advised that the agreement between the successful Contractor and the College shall be executed on the Form of Contract by the College, a copy of which is enclosed in these proposal documents.
- 7.2 Any exceptions to the FORM OF CONTRACT are requested to be included with the price proposal to initiate further consideration by the College. An exception to the FORM OF CONTRACT by the Contractor is considered by the College to be a request for information.
- 7.3 The College makes no implicit or explicit statement as to any willingness to deviate from the FORM OF CONTRACT included in the proposal documents.
- 7.4 Unless explicitly stated by the Contractor in the Proposal Form that an exception to the Form of Contract is a condition of the proposal, the College does not consider exceptions to the Form of Contract provided by a Contractor to be the submission of a conditional proposal.

PART 8 - SUBCONTRACTOR INFORMATION

- 8.1 With its proposal response, using the Subcontractor Information Form included at Section 004513 I-1, Contractor shall submit information on prospective subcontractors under consideration for each of the following key principal trades:
- 1) Curtainwall
 - 2) HVAC/Plumbing
 - 3) Electrical
- 8.2 Information may be submitted for up to three prospective subcontractors per trade category.

- 8.3 Information collected may be used as a point of discussion during Contractor interviews to amplify the College's understanding of the Contractor's approach to assembling an appropriately qualified and experienced project team for the Work.
- 8.4 Submission of Subcontractor Information does not oblige the successful Contractor to restrict subcontract award to one of the subcontractors named on each Form.
- 8.5 The College reserves the right to reject any Subcontractor.

PART 9 - SUBCONTRACTOR QUALIFICATIONS

- 9.1 The College's intent, with regard to verification of Subcontractor qualifications and financial stability, is that it is the Contractor's responsibility to evaluate the qualifications, financial viability and solvency of all Subcontractors.
- 9.2 Unless otherwise indicated in the contract documents, within 3 business days from request by the College, Contractors shall submit to the College for each Principal Subcontractor, herein defined as those Subcontractors whose contract value is anticipated to exceed \$ 100,000.00:
- a) Subcontractor's Qualification Statement, per Section 004513.
 - b) At least three (3) project references, including two projects within the Metropolitan Baltimore-Washington region, documenting successful completion of projects of similar size, scope and complexity, within the last five years.
- 9.3 The College reserves the right to reject any Subcontractor.

PART 10 - TELECOMMUNICATIONS AND ELECTRONIC SECURITY SYSTEM SUBCONTRACTOR QUALIFICATIONS

- 10.1 In addition to satisfying provisions applicable to all subcontractors, specific technical qualification requirements apply to the Telecommunications Subcontractor and the Electronic Security Systems Subcontractor. Refer to Sections 004513-T, Telecommunications Subcontractor Qualifications and 004513-ES, Electronic Security System Subcontractor Qualifications.
- 10.2 The Contractor shall submit the Telecommunications Subcontractor Qualification Statement and Questionnaire required under Section 004513-T, and; the Electronic Security Systems Subcontractor Qualification Statement and Questionnaire required under Section 004513-ES, to the College for review and approval prior to proceeding with the Work.
- 10.3 The College reserves the right to reject any Telecommunications or Electronic Security Systems Subcontractor.

PART 11 - LIST OF SUBCONTRACTORS

- 11.1 Within 3 business days from request by the College, Contractor shall provide names, addresses, Maryland registration/license number, and indication of minority status (if applicable), for all the Subcontractors proposed to be retained by the Contractor for this project, regardless of anticipated contract value.

PART 12 - VENDOR QUALIFICATIONS

- 12.1 The College's intent with regard to verification of Vendor qualifications, and financial stability is that it is the Contractor's responsibility to evaluate the qualifications, financial viability and solvency of all Vendors used for the project.
- 12.2 Within 3 business days from request by the College, Contractor shall submit to the College a Qualification Statement for each Principal Vendor, herein defined as those Vendors whose contract value is anticipated to exceed \$100,000.00, to include the following:
- 1) Name
 - 2) Address
 - 3) Type of Work Performed
 - 4) Years in Business
 - 5) Representative Project List (including three projects of similar size, scope and complexity)
 - 6) References (list three references, including contact name and telephone number)
 - 7) Copy of Maryland registration/license number, if applicable
- 12.3 The College reserves the right to reject any Vendor.

PART 13 – STATE OF MARYLAND PREVAILING WAGE RATES REQUIREMENTS

- 13.1 The State of Maryland Prevailing Wage Rates requirements and reporting procedures apply to this Project. Pursuant to Annotated Code of Maryland State Finance and Procurement, Section §17-201 through 226, it is mandatory upon the successful Contractor and any subcontractor under him, to pay not less than the specific rates to all workers employed by them in executing contracts in this locality. A copy of Prevailing Wage Determination and Instructions for Contractors for this Project is enclosed in Appendix A of the Part B RFP documents.

For additional information or any questions concerning the prevailing wage rates requirements and reporting procedures, please visit State of Maryland Department of Labor, Licensing and Regulation, Division of Labor and Industry website at <http://www.dllr.state.md.us/labor/prev/>, or contact Prevailing Wage Unit by phone at (410) 767-2241, email at dli@dllr.state.md.us.

- 13.2 Effective on July 1, 2013, the State Apprenticeship and Training Fund law requires that Contractors and certain subcontractors performing work on certain public work contracts are required to make contributions toward apprenticeship. See §17-601 through 17-606, State Finance and Procurement, Annotated Code of Maryland.

For additional information or any questions concerning Maryland Apprenticeship and Training Program, please visit State of Maryland Department of Labor, Licensing and Regulation, Division of Labor and Industry website at <http://www.dllr.state.md.us/labor/appr/>, or contact the by phone at (410) 767-2246, email at matp@dllr.state.md.us.

PART 14 – TAXES

- 14.1 Item 29 of the Conditions & Instructions Taxes is not applicable to this project. General Conditions Section 007200 3.5 governs.

END OF SUPPLEMENTARY INSTRUCTIONS, PART B

REQUIRED SUBMISSIONS CHECKLIST, PART B**Science West Renovation
Rockville Campus****TO: SELECTED CONTRACTORS****FROM: PROCUREMENT OFFICE
MONTGOMERY COMMUNITY COLLEGE**

Proposals (**one original and two copies, marked “original” or “copy” accordingly, including all attachments**) shall be submitted on the enclosed Proposal Form, properly signed with the required attachments, if any, in sealed envelopes or boxes and addressed to:

**Director of Procurement
Montgomery Community College
900 Hungerford Drive, Room 110
Rockville, MD 20850**

Any reasonably sized envelope or box may be used. **All submissions must be marked with the submission label provided in specification Section 002113, Instructions to Contractors, Part B.**

PART 1 - ITEMS REQUIRED FOR PRICE PROPOSAL SUBMISSIONS:

1. Price Proposal Form, included at **Section 004213-B**.
2. Addenda receipt acknowledgement. Include signed copy of last page of each Addendum issued.
3. Bid Bond, per **Section 004313**.
4. Bonding Company letter Guaranteeing the Required 100% Performance Bond (Montgomery College Standard Performance Bond, included at **Section 006113.13**) and Labor and Material Payment Bond (AIA Form A312-2010, per **Section 006113.16**).
5. Verification of Examination of Site Conditions Form, included at **Section 004400**.
6. Updated Minority Participation Form, included at **Section 004539**.
7. Any exceptions to the Form of Contract, for evaluation by the College.

PART 2 - ITEMS REQUIRED FOR SUBCONTRACTOR INFORMATION SUBMISSIONS:

1. Subcontractor Information Form, included at Section 004513 I-1, for each of up to three prospective Key Principal Subcontractors per trade category for each of the following trade categories:
 - 1) Curtainwall
 - 2) HVAC/Plumbing
 - 3) Electrical

END OF REQUIRED SUBMISSIONS CHECKLIST, PART B

INFORMATION AVAILABLE TO CONTRACTORS, PART B**Science West Renovation
Rockville Campus**

1.1 GENERAL PROVISIONS

- A. College records include documentation that is made available as information to Contractors to illuminate likely project conditions.
- B. Reports, investigations, data, as-built documentation, and all information related thereto included as Information Available to Contractors are not a part of the Contract Documents.
- C. The College, Architect and Engineers do not guarantee continuity of conditions indicated and are not responsible for information contained or not contained in the Information Available to Contractors.
- D. Contractors shall employ their own experts to analyze available information. Contractors shall be responsible for the consequences of acting on conclusions obtained from examination and analysis of available information.
- E. Documentation may be examined by submitting a written request to:

Peter Hanley, Senior Project Manager
Email: peter.hanley@montgomerycollege.edu

1.2 SOIL INVESTIGATION DATA

- A. Subsurface soil investigations have been made at and adjacent the site and the results of those investigations have been reported to the College. The investigations were conducted by:
 - Schnabel Engineering
 - 656 Quince Orchard Boulevard – Suite 700
 - Gaithersburg, MD 20878
- B. Copies of the reports are made available as separately bound reference documents entitled Geotechnical Data.

1.3 FOREST CONSERVATION PLAN DATA

- A. Forest Conservation Plan documents are made available as separately bound reference documents entitled FCP Documents.

1.4 HAZARDOUS MATERIALS DATA

- A. Bidders are advised that the Science West building is known to contain materials that are now considered hazardous, including asbestos. The College will separately provide for Science West abatement services as required for the project. Documentation as to the nature and extent of hazardous materials, as well as records pertaining to abatement services necessary in the conduct of the work, are available from the College's Environmental Safety office.

1.5 CONSTRUCTION LOGISTICS CONCEPT PLANS – LGST Series

- A. Bidders are advised that sample plans were prepared during the project’s design phase to illustrate campus and regulatory constraints for accessing the site and the sequencing of work in occupied portions of Science East, Science West and the Science Center.
- B. This illustrated concept is for reference only and may not represent all construction conditions. The final determination for the means and methods of sequencing the work in a manner acceptable to Montgomery College and the Authority Having Jurisdiction (City of Rockville) shall be developed by contractor.
- C. Copies of these drawings are made available as separately bound reference documents entitled LGST-Series Reference Plans.

1.6 SCIENCE EAST CONSTRUCTION DOCUMENTS

As-Built documentation is available for the project worksite.

1.7 SCIENCE WEST CONSTRUCTION DOCUMENTS

As-Built documentation is available for the project worksite.

1.8 SCIENCE CENTER CONSTRUCTION DOCUMENTS

As-Built documentation is available for the project worksite.

1.9 ROCKVILLE CAMPUS UTILITY REFERENCE DATA

As-Built documentation is available for the project worksite.

END OF INFORMATION AVAILABLE TO CONTRACTORS, PART B

PRICE PROPOSAL FORM

**Montgomery College
Request for Proposal
Part B: Interview and Price Proposal**

**Science West Renovation
Rockville Campus**

To: Montgomery College

**Re: Request for Proposal
Part B: Interview, Subcontractor Information & Price Proposal
Science West Renovation
Rockville Campus**

Attn.: Procurement Office
Montgomery Community College
900 Hungerford Drive – Room 110
Rockville, Maryland 20850

From: _____
(Provide Your Company’s Name)

PART 1 - Contractor must submit **an original plus two copies**, marked “original” or “copy” accordingly, of the Price Proposal Form and all attachments.

PART 2 - Please read the questions, note what is requested, then provide appropriate responses. Failure to answer any of the applicable questions contained in this section will make the proposal non-responsive and grounds for rejection of the entire proposal. **Conditional proposals will not be accepted.**

PART 3 - Contractor acknowledges receipt of the following addenda:

Number _____ Date _____

Number _____ Date _____

Number _____ Date _____

Number _____ Date _____

Number _____ Date _____

PART 4 - BASE PRICE: (State amounts in both words and numbers)

The proposed total contract amount to complete the **Science West Renovation** at the Rockville Campus, including the cost associated with Performance and Labor and Material Payment Bonds, and including the cost associated with any Separately Identified Price if requested in Part 5 below, in accordance with the contract documents, and having examined both the Place of the Work and all matters referred to in the contract documents, is:

Base Price Detail (In Numbers):

1 – General Conditions	\$ _____
2 – Existing Conditions	\$ _____
3 – Concrete	\$ _____
4 – Masonry	\$ _____
5 – Metals	\$ _____
6 – Wood, Plastics & Composites	\$ _____
7 – Thermal and Moisture Protection	\$ _____
8 – Doors and Windows, Hardware, Openings	\$ _____
9 – Finishes	\$ _____
10 – Specialties	\$ _____
11 – Equipment	\$ _____
12 – Furnishings	\$ _____
13 – Special Construction	\$ _____
14 – Conveying Systems	\$ _____
21 – Fire Suppression	\$ _____
22 – Plumbing	\$ _____
23 – Heating Ventilation & Air Conditioning	\$ _____
26 – Electrical	\$ _____
27 – Communications	\$ _____
28 – Electronic Safety and Security	\$ _____

31 – Earthwork \$ _____

32 – Exterior Improvements \$ _____

33 – Utilities \$ _____

Construction Cost Subtotal: \$ _____

Overhead \$ _____

Profit \$ _____

Insurance \$ _____

Performance, Labor and Material Payment Bonds \$ _____

Builder’s Risk \$ _____

Construction Cost Total:
(Base Price Total) \$ _____

Base Price Total:

(In Words): _____ **Dollars**

(In Numbers): \$ _____

PART 5 - SPECIAL PRICING REQUIREMENTS: (State amounts in both words and numbers)**A. DEDUCT ALTERNATES – NOT USED****B. ADD ALTERNATES – NOT USED****C. UNIT PRICES – NOT USED**

Provide unit prices to establish a fixed basis for costs for adding or changing specified quantities of work from those indicated in the contract drawings and specifications, when directed in writing by the College to make such changes. The unit prices shall include all labor, materials, equipment, overhead, bonds, insurance and profit.

Unit Price No. 1 – Removal of contaminated soil.

If contaminated soil is encountered during excavation, remove and properly dispose of the contaminated soil.

Unit Price: (In Words): _____ Dollars per Cubic Yard
(In Numbers): \$ _____/CY

D. SEPARATELY IDENTIFIED PRICES – NOT USED**PART 6 - BID SURETY**

A. The bid surety attached in the sum of _____ Dollars (\$ _____) is to become the property of the College in the event the Contract and Bond are not executed with the time set forth, as liquidated damages for the delay and additional expense to the College caused thereby.

B. The undersigned includes the following submissions as part of the Price Proposal Form:

Bid Bond (AIA Form A310, "Bid Bond")
Bonding Company Letter

PART 7 - The undersigned acknowledges the right of the College in its sole discretion to accept any Proposal or to reject any or all Proposals.

PART 8 – The undersigned agrees that if he/she is selected as the Contractor he/she will, within five (5) days, Saturdays, Sundays and legal holidays excluded, after presentation thereof by the College, execute a Contract in accordance with the terms of this Solicitation and Contract Documents.

PART 9 – Upon contract award, the undersigned agrees to hold prices firm for the duration of the overall contract term.

PART 10 - The undersigned further certifies under the penalties of perjury that this proposal is in every respect bona-fide, fair and made without collusion or fraud with another person, joint venture, corporation, partnership or other business or legal entity.

PART 11 - SIGNATURES:

(Date) _____ (Company Name)

(Address)

(Telephone Number)

(Facsimile Number)

By: _____
SEAL IF A CORPORATION Authorized Agent & Title (Print)

Signature

(F.I.N.)

(Contractor License Number)

BE SURE YOU SIGN YOUR PROPOSAL

BID BOND

Montgomery College

**Science West Renovation
Rockville Campus**

Use AIA Document A310, Bid Bond, 2010 edition.

**VERIFICATION OF
EXAMINATION OF SITE CONDITIONS**

Montgomery College

**Science West Renovation
Rockville Campus**

This form must be completed and included with the Price Proposal.

The undersigned hereby certifies completion of examination of the site conditions at a site inspection on _____, 2014:

Date

Company Name

Address

Telephone Number

Facsimile Number

Name & Title (Print)

Signature

Site examination inspection confirmed by College Representative:

Date

College Representative Name & Title

Signature

SUBCONTRACTOR'S QUALIFICATION STATEMENT

**Science West Renovation
Germantown Campus**

Use AIA Document A305, Contractor's Qualification Statement, latest edition, unless otherwise indicated

SUBCONTRACTOR INFORMATION FORM

**Science West Renovation
Rockville Campus**

Trade: _____

Name: _____

Address: _____

Telephone: _____

Contact: _____

Average Annual Work performed, in dollars, last three years: _____

List three representative projects of comparable size, scope and complexity, completed within the last five years. For each project, indicate client name, project location, completion date, size, cost and major features:

Project # 1 _____

Project # 2 _____

Project # 3 _____

ELECTRONIC SECURITY SYSTEM SUBCONTRACTOR QUALIFICATION STATEMENT**Science West Renovation
Rockville Campus****PART 1 - SUBMITTAL REQUIREMENTS**

- 1.1 Contractor must submit for College's approval a complete Electronic Security System Subcontractor Qualification Statement, including the following Questionnaire, prior to the start of work.

PART 2 - TECHNICAL QUALIFICATION REQUIREMENTS AND EVALUATION CRITERIA

- 2.1 The Electronic Security System Subcontractor shall prepare a qualification statement must address, at a minimum, the following areas of inquiry:

2.1.1 General Industry Experience:

Electronic Security System Subcontractors are required to have provided electronic security systems at commercial, governmental or academic institutions within the Metropolitan Baltimore-Washington area for a period of not less than 3 years.

- State number of years in electronic security systems installation business.

2.1.2 Electronic Security System Subcontractor must be a Lenel Strategic Partner.

- Submit evidence proving Contractor's status as a Lenel Strategic Partner.

2.1.3 Relevant Experience:

The Electronic Security System Subcontractor **MUST** provide evidence of its ability to perform electronic security systems installation in accordance with referenced standards contained within the contract documents.

- List three (3) prior project references that included requirements similar to those required in this contract, along with the location, contact person, current telephone number, and a short narrative description detailing the scope of the project. Descriptions shall include wiring closet installation, wiring types, cable routes and supporting electrical installation (if any).

2.1.4 Facilities Commander WnX Certification:

Electronic Security System Subcontractor shall possess current Lenel certifications and a minimum of two certified (2) Facilities Commander WnX technicians assigned to the performance of this contract.

- Submit copies of Facilities Commander WnX Certifications.

2.1.5 Sufficient, Qualified Staff:

Electronic Security System Subcontractors shall have currently in their employ sufficient staff to provide the required work per specifications in this Request for Proposal, including sufficient qualified staff to accommodate a project that requires a minimum crew of two (2) people at the job site.

- Include a brief description on a separate sheet, of personnel that will be assigned to work on project. Include copies of resumes, certifications, manufacturer training, technical schooling and background showing qualifications and length of current employment of field staff to be assigned to this contract with this statement.

2.2 The Electronic Security System Subcontractor shall complete the attached questionnaire and include it as an appendix to the Electronic Security System Qualification Statement prepared for section 2.1.

2.3 The College shall be the sole judge in determining whether an Electronic Security System Subcontractor is qualified. In evaluating the Electronic Security System Subcontractor's qualifications, consideration shall be given to items including, but not limited to, the reputation and experience of the Electronic Security System Subcontractor, the quality of performance on previous contracts or services, either with the college or with other customers.

2.4 The Electronic Security System Subcontractor may be contacted to clarify information contained in this Electronic Security System Subcontractor Qualification Statement. The College is the sole judge regarding the qualification of the Electronic Security System Subcontractor. The College's decision will be final.

**END ELECTRONIC SECURITY SYSTEM SUBCONTRACTOR QUALIFICATION
STATEMENT**

Questionnaire

The College reserves all rights as to the evaluation of any and all responses to the Electronic Security System Subcontractor Qualification Statement and as to the final determination regarding Electronic Security System Subcontractor qualification.

COMPLETE THE FOLLOWING. ATTACH ADDITIONAL SHEETS AS REQUIRED.

Company: _____ Contact: _____
 Address: _____ Title _____
 _____ Tel. No. _____

Organization:

➤ How long has firm been in business under its present business name?

➤ Has firm ever Traded under any other name? ____ Yes ____ No
 If yes, please list name(s) and address(s):

List Period of Time Trading Under this Name _____

➤ Is firm a corporation? ____ Yes ____ No
 Provide:
 Date of Incorporation _____
 State of Incorporation _____
 President's Name _____
 Vice President(s) Name(s) _____
 Secretary's Name _____
 Treasurer's Name _____

➤ Is firm a partnership? ____ Yes ____ No
 Provide:
 Date of Organization _____
 Type of Partnership _____
 Name(s) of General Partners:

- Is firm individually owned? _____ Yes _____ No
 Provide:
 Date of Organization _____
 Name of Owner _____

- Is firm other than those listed above? _____ Yes _____ No
 If yes,
 Describe organization and name the principals.

- What is the prime service, product or function of firm?

- Number of employees? _____

- Is the firm presently registered with the State of Maryland? ____ Yes ____ No
 If yes, please list type of registration(s):

- Average daily number of on-site employees to be assigned to this project as described in this Request for Proposal

TOTAL NUMBER:	Technician	_____
	Helper	_____

On separate attached sheet(s) of paper, list the names and describe previous experience by the overall Project Manager and the General Site Superintendent who will be assigned to the College’s project in cable installation of projects of similar size and scope.

- Subcontractor References:
 Attach a list of the three (3) most recent projects of similar scope, size and complexity to the work required by the College in this Request for Proposal. A minimum of two of the listed projects must be from the Washington Metropolitan area (Including Baltimore, Maryland or Frederick, Maryland). This list must include name; address; telephone number; contract person; location of work performed; description of project; value of work; indication of whether work took place in occupied facilities; name, address, telephone number, contact person of firm providing site monitoring.

I, hereby, certify that the information provided in this statement is true and correct to the best of my knowledge and belief.

(Company Name)

(Authorized Signature)

(Type or Print Signature Name)

(Title)

(Date)

TELECOMMUNICATIONS SUBCONTRACTOR QUALIFICATION STATEMENT**Science West Renovation
Rockville Campus****PART 1 - SUBMITTAL REQUIREMENTS**

- 1.1 Contractor must submit for College's approval a complete Telecommunications Subcontractor Qualification Statement, including the following Questionnaire, prior to the start of work.

PART 2 - TECHNICAL QUALIFICATION REQUIREMENTS AND EVALUATION CRITERIA

- 2.1 The Telecommunications Subcontractor shall prepare a qualification statement that must address, at a minimum, the following areas of inquiry:

2.1.1 General Industry Experience:

Telecommunications Subcontractors are required to have engaged in cable installation at commercial, governmental or education institutional agencies within the Metropolitan Washington area (including Baltimore) for a period of not less than 3 years.

- State number of years in cable installation business.

2.1.2 Understanding of Industry and College Cabling Standards:

- a. The Telecommunications Subcontractor **MUST** provide a statement demonstrating that they understand the scope of the work as outlined in this Request for Proposal.

- Submit relevant Understanding of Scope of Work statement.

- b. The Telecommunications Subcontractor **MUST** describe the approach that they propose to use in fulfilling the College's requirements including the Telecommunications Subcontractor's understanding of Industry and College cabling standards.

- Submit relevant Project Approach statement.

2.1.3 Relevant Building-Wide Wiring Installation Experience:

The Telecommunications Subcontractor **MUST** provide evidence of its ability to perform building-wide wiring installations of copper cabling and Category 6 unshielded twisted pair (UTP) cabling, 62.5 multi-mode and single-mode optical fiber cabling in accordance with referenced standards contained within the contract documents.

- List three (3) prior project references that included requirements similar to those required in this contract, along with the location, contact person, current telephone number, and a short narrative description detailing the scope of the project. Descriptions shall include wiring closet installation, wiring types, cable routes and supporting electrical installation (if any).

2.1.4 Sufficient, Qualified Staff:

Telecommunications Subcontractors shall have currently in their employ sufficient staff to provide the required work per specifications in this Request for Proposal, including sufficient qualified staff to accommodate a project that requires a minimum crew of two (2) people at the job site. A crew consists of a minimum of 1 qualified technician and 1 helper.

- State number of qualified support staff available to complete project as required.
- Include a brief description on a separate sheet, of personnel that will be assigned to work on project. Include copies of resumes, certifications, manufacturer training, technical schooling and background showing qualifications and length of current employment of field staff to be assigned to this contract with this statement.

2.1.2 Molex Certification:

Telecommunications Subcontractor shall possess a current Molex Premise Networks certification and be able to deliver to the College the 25 year Product System Performance and Application Assurance Warranty required by the contract documents. The Subcontractor shall have a minimum of two (2) Molex Certified installers as established by Molex Premise Networks, 695 Winding Stream Way #303, Odenton, MD 21113, assigned to this contract.

- Submit copies of Molex Certifications.

2.1.5 Sumitomo Certification:

- a. The Telecommunications Subcontractor shall possess current certification in Sumitomo Electric – FutureFLEX Air Blown Fiber Infrastructure and be able to deliver to the College the 25 year manufacturers product warranty required by the contract documents.
 - Submit copies of Sumitomo certifications.
- b. The Telecommunications Subcontractor MUST employ two (2) engineers who possess ‘Design and Installation’ certification of Training from Sumitomo Electric Lightwave Corp. who are available to service this contract.
 - Submit copies of Sumitomo certifications.

2.1.6 BICSI Certification:

The Telecommunications Subcontractor MUST employ on staff a minimum of one (1) BICSI certified RCDD designer and (1) BICSI LAN Specialist throughout the life of the contract.

- Submit copies of resumes, professional licenses, certifications, manufacturer training, technical schooling and background showing qualifications and length of current employment of field staff to be assigned to this contract.

2.1.7 Specific Testing Device Capability:

The Telecommunications Subcontractor MUST possess and demonstrate the ability to use both an Optical Time Domain Reflectometer (OTDR) and a Microtest Pentascanner or equivalent.

- Provide evidence of its ability to use these testing devices by submitting samples of reports in the manner required in the cable testing section of the contract documents.

2.1.8 Specific Termination Capability:

The Telecommunications Subcontractor, and/or any specified sub-subcontractor, MUST possess and demonstrate the ability to install and terminate the following: Belden (TRIAx cable), King (TRIAx Connectors), and Neutrik (XLR Connectors).

- List two (2) prior reference projects that included requirements similar to those listed above, along with the location, contact person, current telephone number, and a short narrative description detailing the scope of the project.

2.2 The Telecommunications Subcontractor shall complete the attached questionnaire and include it as an appendix to the Telecommunications Qualification Statement prepared for section 2.1.

2.3 The College shall be the sole judge in determining whether a Telecommunications Subcontractor is qualified. In evaluating the Telecommunications Subcontractor's qualifications, consideration shall be given to items including, but not limited to, the reputation and experience of the Telecommunications Subcontractor, the quality of performance on previous contracts or services, either with the college or with other customers.

2.3 The Telecommunications Subcontractor may be contacted to clarify information contained in this Telecommunication Telecommunications Subcontractor Qualification Statement. The College is the sole judge regarding the qualification of the Telecommunications Subcontractor. The College's decision will be final.

END TELECOMMUNICATIONS SUBCONTRACTOR QUALIFICATION STATEMENT

Questionnaire

The College reserves all rights as to the evaluation of any and all responses to the Telecommunications Subcontractor Qualification Statement and as to the final determination regarding Telecommunications Subcontractor qualification.

COMPLETE THE FOLLOWING. ATTACH ADDITIONAL SHEETS AS REQUIRED.

Company: _____ Contact: _____

Address: _____ Title _____

_____ Tel. No. _____

Organization:

➤ How long has firm been in business under its present business name?

➤ Has firm ever Traded under any other name? ____ Yes ____ No
If yes, please list name(s) and address(s):

List Period of Time Trading Under this Name _____

➤ Is firm a corporation? ____ Yes ____ No
Provide:
Date of Incorporation _____
State of Incorporation _____
President's Name _____
Vice President(s) Name(s) _____
Secretary's Name _____
Treasurer's Name _____

➤ Is firm a partnership? ____ Yes ____ No
Provide:
Date of Organization _____
Type of Partnership _____
Name(s) of General Partners:

- Is firm individually owned? _____ Yes _____ No
 Provide:
 Date of Organization _____
 Name of Owner _____

- Is firm other than those listed above? _____ Yes _____ No
 If yes,
 Describe organization and name the principals.

- What is the prime service, product or function of firm?

- Number of employees? _____

- Is the firm presently registered with the State of Maryland? ____ Yes ____ No
 If yes, please list type of registration(s):

- Average daily number of on-site employees to be assigned to this project as described in this Request for Proposal

TOTAL NUMBER:	Technician	_____
	Helper	_____

On separate attached sheet(s) of paper, list the names and describe previous experience by the overall Project Manager and the General Site Superintendent who will be assigned to the College’s project in cable installation of projects of similar size and scope.

- Subcontractor References:
 Attach a list of the three (3) most recent projects of similar scope, size and complexity to the work required by the College in this Request for Proposal. A minimum of two of the listed projects must be from the Washington Metropolitan area (Including Baltimore, Maryland or Frederick, Maryland). This list must include name; address; telephone number; contract person; location of work performed; description of project; value of work; indication of whether work took place in occupied facilities; name, address, telephone number, contact person of firm providing site monitoring.

I, hereby, certify that the information provided in this statement is true and correct to the best of my knowledge and belief.

(Company Name)

(Authorized Signature)

(Type or Print Signature Name)

(Title)

(Date)

MINORITY PARTICIPATION FORM

Science West Renovation
Rockville Campus

CONTRACTORS SHALL COMPLETE THE FOLLOWING:

I HEREBY REPRESENT THAT OUR/MY FIRM IS _____
IS NOT _____

A MINORITY BUSINESS FIRM AS INDICATED BELOW (circle one):

African American (not Hispanic) _____ Hispanic _____ Asian _____
American Indian/Native American _____ Disabled _____ Female _____

INDICATE EXPECTED MINORITY PARTICIPATION FROM SELF-PERFORMED WORK,
AND/OR WORK PERFORMED BY SUBCONTRACTORS AND/OR VENDORS AS A
PERCENTAGE OF TOTAL CONTRACT PRICE:

Minority Participation Expectation: _____% of Total Contract Price

I hereby certify that the above information is true and correct, to the best of my knowledge and belief.

Firm Name

Signed Date

Type or Print Name

Title

PROCUREMENT OFFICE QUESTIONNAIRE

**Science West Renovation
Rockville Campus**

**MONTGOMERY COLLEGE
Procurement Office**

RFP Number: _____

RFP Title: _____

Please be advised that our company **does not** wish to submit a bid in response to the above-captioned Request for Bid for the following reasons:

- Too Busy at this time
- Not engaged in this type of work
- Project too large/ small
- Cannot meet mandatory specifications (Please specify below)
- Other (Please specify)

SIGNATURE

PRINTED NAME

TITLE

DATE

COMPANY

Address

Please return to:
Montgomery Community College
Procurement Office
900 Hungerford Drive, Room 110
Rockville, Maryland 20850-1733

CONTRACT
BETWEEN
MONTGOMERY COMMUNITY COLLEGE
AND

Board of Trustees
Montgomery Community College
Rockville, Maryland 20850

Project Title: _____

Contract No.: _____

Account No.: _____

This AGREEMENT made this _____ day of _____, 201____, by and between the Board of Trustees of MONTGOMERY COMMUNITY COLLEGE, a public institution of higher education, hereinafter called the "College", and _____, a _____, registered in the State of _____, located at _____, hereinafter called the "Contractor".

WITNESSETH, that the College and the Contractor for the consideration named agree as follows:

1 QUALIFICATIONS OF THE CONTRACTOR

The Contractor hereby assures the College that the Contractor is qualified to perform the services provided for in this Agreement in accordance with all applicable laws, orders, rules and regulations. The Contractor further assures the College that the Contractor is free from any financial interests which may conflict with the proper performance of this Agreement.

2 DEFINITION OF THE PROJECT

The Contractor agrees to provide all of the necessary labor, materials, equipment and insurance to perform all of the Work described in the Contract Documents. The Work to be performed by the Contractor shall include all items accepted by the College as part of the Contractor's bid submittal, base bid and alternate prices.

3 TIME OF COMPLETION

The Work to be performed under this Agreement shall be in accordance with the Preliminary Project Schedule contained in the Contract Documents. It is agreed that time is of the essence and therefore the College will suffer substantial damages if the Work is not completed within the time stated in the Preliminary Project Schedule contained in the Contract Documents.

4 LIQUIDATED DAMAGES

It is agreed that time is of the essence and therefore the College will suffer substantial damages if the Work is not completed within the time stated in the Preliminary Project Schedule contained in the Contract Documents. If the Contractor fails to achieve Substantial Completion of its Work on or before the date set for Substantial Completion of the Contract and as a result causes the Project to be completed after the date set for Substantial Completion of the Project as set forth in the Preliminary Project Schedule, liquidated damages shall be assessed against the Contractor in the amount of **\$ 5,000** per day for each calendar day that the Contractor delays Substantial Completion of the Project. These assessed damages shall not be considered as a penalty but as mutually agreed upon as the ascertained damages suffered by the College because of the delay. Where, under the contract, additional time is allowed for the completion of the work, the new time limits will be the essence of the contract.

5 CONTRACT DOCUMENTS

The Contract Documents are the Agreement, the Request for Proposal, Instructions to Contractors, Supplementary Instructions, the General Conditions of the Contract, Supplementary Conditions, Preliminary Project Schedule, Drawings, Specifications, Addenda issued prior to execution of the Contract, Modifications issued after execution of the Contract, the Performance Bond, the Labor and Material Payment Bond, the Contractor's Bid Form and all attachments thereto received from the Contractor. The term "Contract" when used in the Specifications or Drawings shall be considered as synonymous with the term "Contract Documents".

6 CHANGES TO THE CONTRACT

The College may make any alterations, deviations, additions or omissions to the Contract Documents which it deems to be in the best interest of the College without otherwise affecting the obligations of the Contractor or making void this Agreement. Any alterations, deviations, additions or omissions shall be processed as a change order in the Work and shall be prepared in accordance with the procedure set forth for issuing changes in the Work in the Contract Documents.

7 CONTRACT SUM

The College shall pay the Contractor the Contract Sum of _____ Dollars (\$ _____ .00) for the Work performed strictly in accordance with the requirements of this Agreement. All invoices submitted for Work performed under this Agreement shall include the College's project title, contract number and account number. The Contract Sum is a firm lump sum paid in accordance with the General Conditions of this Agreement.

8 PROGRESS PAYMENTS

Payments shall be made to the Contractor on a monthly basis provided that the Contractor submits Applications for Payments which are prepared in accordance with the General Conditions and supported by such data as the College may reasonably require. The College shall have the right to audit the Contractor's records to verify the payment request. Payment shall be made within ten (10) calendar days after the requisition, properly prepared and authorized by the College representative, is received in the Finance Office.

9 ACCEPTANCE AND FINAL PAYMENT

- 9.1 Upon receipt of written notice from the Contractor that the Work is ready for final inspection and acceptance, the College and/or its representatives shall promptly make such final inspection. When the College Representative finds the Work fully acceptable under the Agreement and the Agreement fully performed, the College Representative shall issue a final certificate stating that the Work provided for in this Agreement has been completed and is acceptable under the terms and conditions thereof and that the entire balance found to be due to the Contractor and noted in the final certificate is due and payable. Before issuance of a final certificate, the Contractor shall submit such evidence the College deems necessary to ensure that all payrolls, materials bills and other indebtedness connected with the Work have been paid. Final payment shall be made within (15) fifteen calendar days after the issuance of a final certificate from the College's Representative that the Work has been fully completed and the Agreement fully performed.
- 9.2 Neither the acceptance by the College or any representative of the College nor any payment for or acceptance of the whole or any part of the Work, nor any extension of time, nor any possession taken by the College, shall operate as a waiver of any portion of the Agreement or of any power reserved to the College or any right to recover damages. The waiver of any breach of the Agreement shall not be held to be a waiver of any other prior or subsequent breach.

10 NOTICES

Any notice to be provided shall be sent by first class mail and shall be addressed as follows or as may be later designated in writing:

a) For the College: Dr. G. Dewey Yeatts, CEFP
 Vice President of Facilities & Security
 Montgomery College
 Office of Central Facilities
 40 West Gude Drive, Suite 200
 Rockville, Maryland 20850

b) For the Contractor: _____

11 INTERPRETATION OF CONTRACT

This Agreement is a contract under seal and shall be construed and interpreted according to the laws of the State of Maryland, without regard to principles of conflicts of law.

12 COMPLIANCE WITH LAWS

The Contractor agrees to comply, at no additional expense, with all applicable Executive Orders, Federal, State, county, bi-county, regional and local laws, ordinances, rules and regulations in effect as of the date of this Agreement and as they may be amended from time to time, including but not limited to the equal opportunity clause set forth in 41 CFR 60-250.4 as amended. The Contractor shall further agree to comply with any special provisions or requirements, including more stringent provisions, mandated by any entity having jurisdiction.

13 INDEPENDENT CONTRACTOR

The Contractor shall perform the Contract as an independent contractor and shall not be considered as an agent of the College nor shall any employee or agent of the Contractor be considered subagents of the College. Nothing in this Contract shall be construed as constituting a partnership, joint venture, or agency between the College and Contractor. Other than duties of the Construction Manager based on authority granted to the Construction Manager by the College, no acts performed or representations, whether oral or written, made by or with respect to third parties and the Contractor shall be binding on the College.

14 NONDISCRIMINATION

- 14.1 The Contractor assures the College that, in accordance with applicable law, it does not, and agrees that it will not discriminate in any manner on the basis of sex, race, age, color, creed, national origin, religious belief, pregnancy, handicap, marital status or status as a disabled veteran or veteran of the Vietnam era. The Contractor further agrees to post in conspicuous places notices setting for the provisions of the non-discrimination clause and to take affirmative action in accordance with applicable law to implement these provisions.
- 14.2 The Contractor further assures the College that, in accordance with the Immigration Reform and Control Act of 1986, it does not and will not discriminate against an individual with respect to hiring, or recruitment or referral for a fee, of the individual for employment or the discharging of the individual from employment because of such individual's national origin or in the case of a citizen or intending citizen, because of such individual's citizenship status.
- 14.3 The College is committed to providing a work and study environment that is free from discrimination and harassment on the basis of sex, race, age, color, creed, national origin, religious belief, pregnancy, handicap, marital status or status as a disabled veteran or veteran of the Vietnam era. Behavior contrary to this philosophy, which has the purpose or effect of creating an intimidating, hostile, or offensive environment, will not be tolerated by the College, and it is the Contractor's responsibility to ensure that such behavior by its employees, agents and subcontractors does not occur.
- 14.4 This policy extends to maintaining an environment free from sexual harassment. Therefore, sexual advances or sexual remarks, requests for sexual favors, and other verbal or physical conduct of a sexual nature must not be condoned or permitted by the Contractor. This prohibition extends to such harassment within the employment context as well as harassment of students, staff and visitors of the College. It should be assumed that all sexual behavior by the Contractor's employees, agents and subcontractors on any campus or facility of the College is improper and unwelcome.

15 COMPLIANCE WITH THE IMMIGRATION REFORM AND CONTROL ACT OF 1986

The Contractor warrants that both the Contractor and/or any subcontractor of the Contractor do not and shall not hire, recruit or refer for a fee, for employment under this Agreement or any subcontract, an alien knowing the alien is an unauthorized alien and hire any individual without complying with the requirements of the Immigration Reform and Control Act of 1986 (hereinafter referred to as "IRCA"), including but not limited to any verification and record keeping requirements. The Contractor agrees to indemnify and save the College, its employees and/or trustees harmless from any loss, costs, damages or other expenses suffered or incurred by the College, its employees and/or trustees by reason of the Contractor's or any subcontractor of the Contractor's noncompliance with "IRCA." The Contractor agrees to defend the College, its employees and/or trustees in any proceeding, action or suit brought against the College, including but not limited to administrative and judicial proceedings, arising out of or alleging noncompliance of the Contractor with "IRCA." The Contractor recognizes that it is the Contractor's responsibility to ensure that all certifications and verifications as required by law are obtained and maintained for the applicable time period.

16 ASSURANCE OF NONCONVICTION OF BRIBERY

The Contractor hereby declares and affirms that, to its best knowledge, none of its officers, directors or partners and none of its employees directly involved in obtaining contracts has been convicted of bribery, attempted bribery or conspiracy to bribe under the laws of any state or the Federal Government.

17 CONFLICT OF INTEREST

No employee of the College or of the State of Maryland, or any department, commission, agency or branch thereof whose duties as such employee include matters relating to or affecting the subject matter of this Agreement shall, until such time as the Contractor receives final payment, become or be an employee of the party or parties hereby contracting with the College, the State of Maryland, or any department, commission, agency or branch thereof.

18 ASSIGNMENT AND SUBCONTRACTING

- 18.1 Neither the College nor the Contractor shall sell, transfer, assign or otherwise dispose of this Agreement or any portion thereof, or its right, title or interest therein, or its obligations there under, without the written consent of the other. A change in membership of the Contractor's firm of one or more officers shall not constitute an assignment.
- 18.2 The Contractor shall not make any contracts for professional services with any other party for furnishing any of the work or services to be performed under this Agreement without the written approval of the College; however, this provision shall not be taken as requiring the approval of the contract of employment between the Contractor and its personnel assigned for the purposes of performing this Agreement.

19 INSURANCE

19.1 The Contractor shall maintain in force at all times during the term of this Agreement, with an insurance carrier licensed to do business in the State of Maryland acceptable to the College, the following minimum insurance coverage. This insurance must be kept in full force and effect during the term of this contract, including all extensions. The insurance must be evidenced by a certificate of insurance, and if requested by the College, the proposed awardees/Contractor shall provide a copy of the insurance policies. The Contractor's insurance shall be primary.

- a) Worker's Compensation Insurance covering the Contractor's employees as required by State of Maryland law with the following minimum limits:

Bodily Injury by Accident	\$ 100,000 each accident
Bodily Injury by Disease	\$ 500,000 policy limit
Bodily Injury by Disease	\$ 100,000 each employee.

- b) Commercial General Liability Insurance, excluding automobiles owned or hired by the Contractor, with limits as follows

Bodily Injury and Property Damage:	\$ 10,000,000 combined single limit of bodily injury and property damage per occurrence
------------------------------------	---

- c) Comprehensive Automobile Liability Insurance, providing bodily injury and property damage coverage for owned vehicles, hired vehicles and non-owned vehicles with limits as follows:

Bodily Injury:	\$ 1,000,000 each person \$ 2,000,000 each occurrence
Property Damage:	\$ 2,000,000 each occurrence

- d) Builder's Risk Insurance, providing property damage coverage and theft replacement coverage for goods provided and services rendered during construction. For renovation projects, when custody of the building is turned over to the Contractor, the Builder's Risk policy must additionally include building replacement value.

- e) Insured - The College, its elected and appointed officials, officers, consultants, agents and employees must be named as additional insured and loss payee on Contractor's Commercial and Excess/Umbrella Insurance for liability arising out of Contractor's products, goods and services provided under this Agreement.

19.2 At the time this Agreement is made, the Contractor shall provide the College with evidence of payment for the above insurance coverage as resulted by this Agreement. Any request for extension of time of this Agreement shall also include evidence of payment for the above insurance coverage as required by an extension of time for this Agreement.

19.3 These coverages and limits are to be considered minimum requirements under this Agreement and shall in no way limit the liability or obligations of the Contractor. The insurance shall provide that policy coverage will not be canceled, altered or materially changed without sixty (60) calendar days' prior notice to the College by registered or certified mail. The insurance shall not be limited to claims made only while the policy is in effect.

- 19.4 The Contractor shall furnish the College with a certificate of insurance as evidence of the required coverage. The certificates of insurance must name the College as an additional insured.
- 19.5 In the event that the Contractor's insurance is terminated, the Contractor shall immediately obtain other coverage and any lack of insurance shall be grounds for immediate termination of this Agreement.
- 19.6 For the purposes of this article, the word "licensed" shall be deemed to mean an insurance carrier either licensed or approved to do business in the State of Maryland.

20 SAVE HARMLESS

- 20.1 The Contractor shall be responsible for any property damage, loss, personal injury, death and/or any other damage which may occur by reason of the Contractor's acts, negligence, willfulness or failure to perform any of the obligations required by this Agreement. The Contractor agrees to indemnify and save harmless the College and its respective employees, volunteers, students, and trustees, as applicable, (the "Indemnitees") from any claims, loss, costs, damages or other expenses suffered or incurred by the Indemnitees, including attorneys fees and costs, by reason of the Contractor's acts, negligence, willfulness or failure to perform any of the obligations required by this Agreement. The Contractor at its own expense shall defend the Indemnitees in any action or suit brought against any of the Indemnitees arising out of the Contractor's acts, negligence, willfulness or failure to perform any of the obligations required by this Agreement. Any acts, negligence, willfulness or failure to perform any of the obligations required by this Agreement on the part of any agent, servant, employee or Subcontractor of the Contractor, or any Subcontractor's agent, servant or employee, are deemed to be the Contractor's acts, negligence, willfulness or failure to perform any of the obligations defined by this Agreement.
- 20.2 In claims against any person or entity indemnified under subsection 21.1 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under subsection 21.1 shall not be limited by a limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers or workmen's compensation acts, disability benefit acts or other employee benefit acts.
- 20.3 The College may retain such moneys due or to become due the Contractor under this Agreement as it considers necessary until such suits or claims for damages have been settled or otherwise disposed of and satisfactory evidence to that effect has been furnished to the College.
- 20.4 The provisions of this Article shall survive the termination of this Agreement.

21 DISPUTES

Any dispute concerning a question of fact arising under this Agreement which is not disposed of by agreement shall be decided by the President of the College or his designee. Pending the final decision of the dispute, the Contractor shall proceed diligently with the Agreement performance. Nothing hereunder shall be interpreted to preclude the parties from seeking, after completion of the Agreement, any and all remedies provided by law.

22 TERMINATION FOR THE CONVENIENCE OF THE COLLEGE

The performance of the work or services under this Agreement may be terminated by the College, in whole or in part, whenever the President of the College shall deem that termination is in the best interest of the College. In such event, the College shall be liable only for payment in accordance with the payment provisions of this Agreement for work or services performed or furnished prior to the effective date of termination, plus reasonable costs of termination, if any, which costs shall be specifically approved by the College in writing. The Contractor shall not be reimbursed for anticipatory profits. Termination hereunder shall become effective by delivering to the Contractor a written notice of termination upon which date the termination shall become effective.

23 TERMINATION FOR DEFAULT

The performance of the work or services under this Agreement may be terminated by the College, in whole or in part, from time to time, effective upon receipt of notice, whenever the Contractor shall default in the performance of this Agreement and fails to make progress in the prosecution of the contract work or endangers such performance and shall fail to cure such default within ten (10) calendar days period after receipt of written notification from the College specifying the default. Should the Agreement be terminated by the College for failure to perform on the part of the Contractor, no additional compensation shall be paid.

24 DELAY

- 24.1 In the event the performance of work or services under this Agreement is delayed by causes beyond the control of and without the fault or negligence of the Contractor, the College shall have the option to:
- a.) Terminate the Agreement, or
 - b.) Allow the President of the College or his designee to extend the time for performance. No monetary compensation will be awarded for the time extension.
- 24.2 Any changes made in this Agreement as a result of delay shall be in writing. In the event the time for performance of this Agreement is extended beyond the term provided for, all other terms and conditions shall remain in full force and effect.

25 WORK UNDER CONTRACT

Work may not commence under this Contract until all conditions for commencement are met, including execution of the Contract by both parties, compliance with insurance requirements and issuance of any required notice to proceed.

26 CONTINGENT FEES

The Contractor hereby declares and affirms that neither it nor any of its representatives has employed or retained any person, partnership, corporation, or other entity, other than a bona fide employee or agent working for the Contractor, to solicit or secure this Agreement, and that it has not paid or agreed to pay any person, partnership, corporation, or other entity, other than a bona fide employee or agent, any fee or any other consideration contingent on the making of this Agreement.

27 CAPTIONS

The captions and headings contained herein are solely for convenience and reference and do not constitute a part of this Agreement.

28 ENTIRE AGREEMENT

This Agreement and the other items identified as Contract Documents constitute the entire agreement between the parties except that any change orders issued by the College shall automatically be deemed to be part of this Agreement. Any other changes or additions hereto shall not become binding upon any parties until reduced to writing and signed by both parties.

29 AUDIT

The Contractor shall permit audit and fiscal and programmatic monitoring of the Work performed under this Agreement. The College shall have access to and the right to examine and/or audit any records, books, documents and papers of Contractor and any Subcontractor involving transactions related to this Agreement during the term of this Agreement and for a period of three (3) years after final payment under this Agreement, whether or not disputes (including litigation) exist between the parties.

30 REGISTRATION FOR CORPORATIONS NOT INCORPORATED IN THE STATE OF MARYLAND

Pursuant to 7-201 et seq. of the Corporation and Associations Article of the Annotated Code of Maryland, corporations not incorporated in the State of Maryland shall be registered with the State Department of Assessments and Taxation, 301 West Preston Street, Baltimore, Maryland 21201, before doing any interstate or foreign business in this State. By signing this agreement, the Contractor certifies that it has qualified with the Department of Assessments and Taxation.

31 SEVERABILITY

If any provision of this Agreement shall be held illegal, unenforceable, or in conflict with any law governing this Agreement, the validity of the remaining portions shall not be affected thereby.

IN WITNESS WHERETO, the Contractor and the College have hereunto set their hands and seals the day and year first above written.

Montgomery Community College

Witness

By: _____
DeRionne P. Pollard, Ph.D.
President

Date: _____

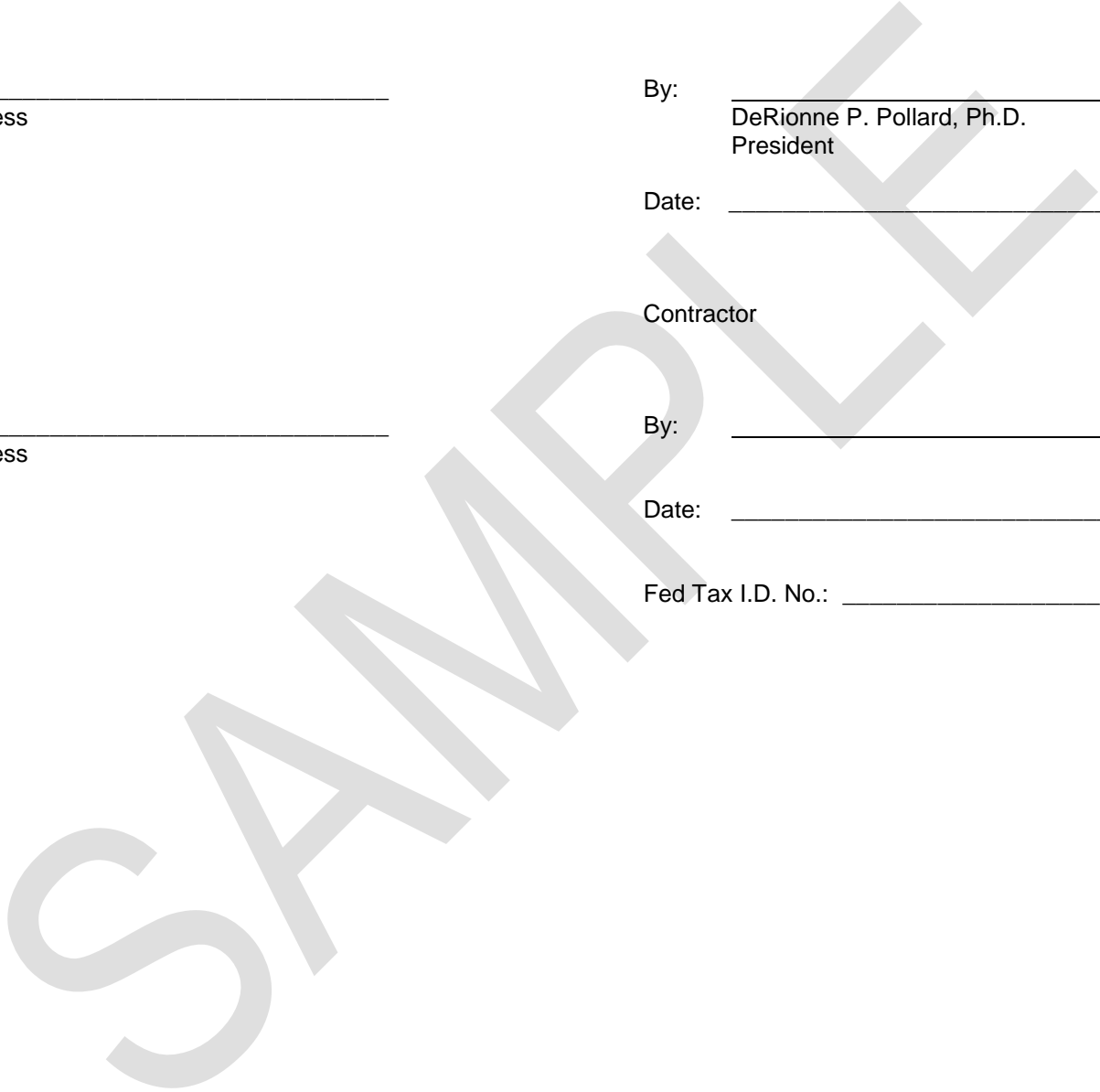
Contractor

Witness

By: _____

Date: _____

Fed Tax I.D. No.: _____



This contract is executed by the Montgomery Community College Board of Trustees pursuant to Board Resolution No. _____, dated _____.

Certify that this Contract has been prepared in accordance with College Policy and Procedures and certify as Account Manager for this account.

G. Dewey Yeatts
Vice President of Facilities & Security

Date

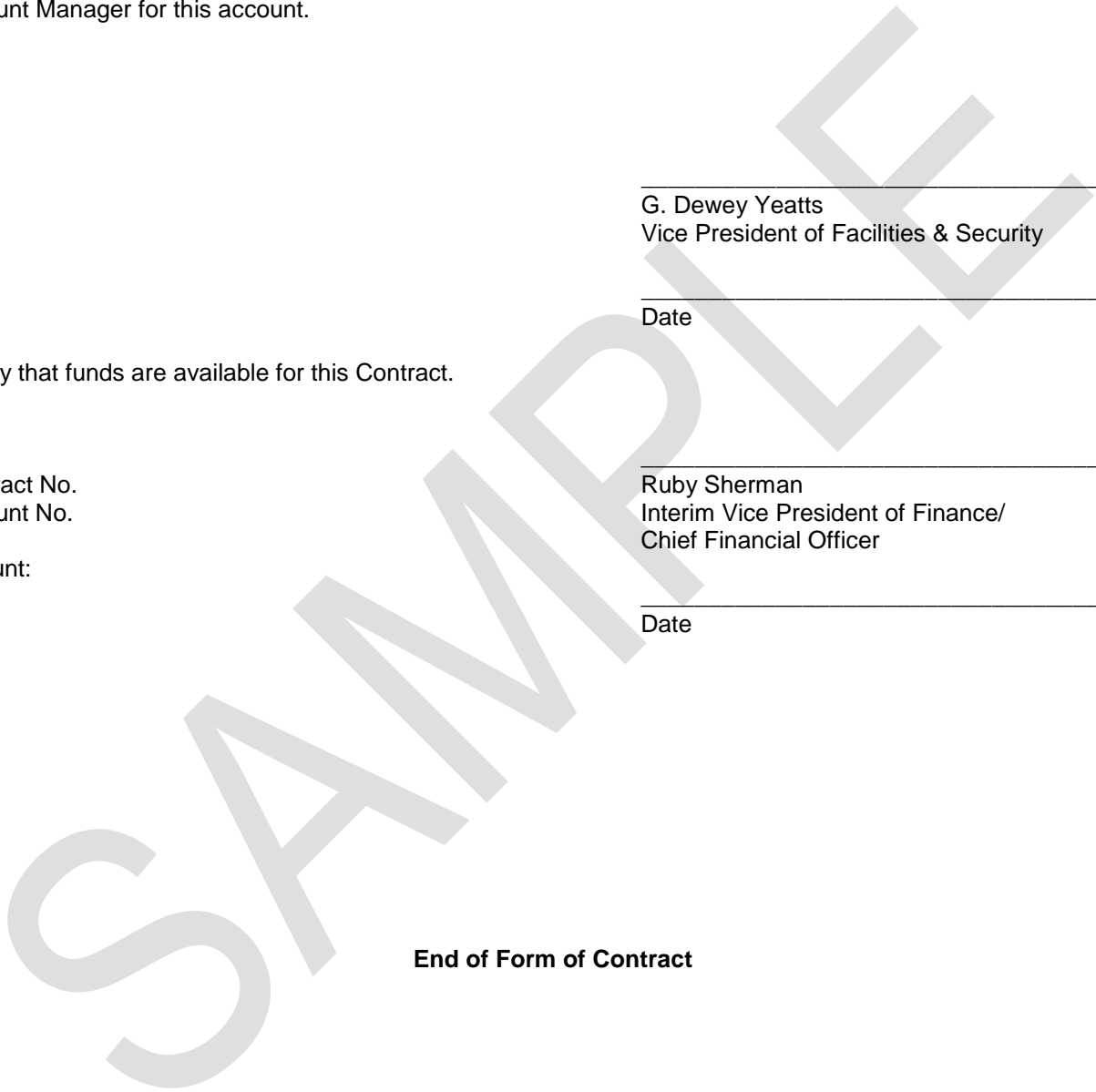
Certify that funds are available for this Contract.

Contract No.
Account No.

Ruby Sherman
Interim Vice President of Finance/
Chief Financial Officer

Amount:

Date



End of Form of Contract

Montgomery College
Standard Performance Bond

Any singular reference to Contract, Surety, Owner or Other Party shall be considered plural where applicable.

CONTRACTOR (*Name and Address*):

SURETY (*Name and Principle Place of Business*):

OWNER (*Name and Address*):

CONSTRUCTION CONTRACT

Date:

Amount:

Description (*Name and Location*):

BOND

Date (*Not earlier than Construction Contract Dated*):

Amount:

Modifications to this Bond:

None

See Page 3

CONTRACTOR AS PRINCIPAL

SURETY

Company:

(Corporate Seal)

Company:

(Corporate Seal)

Signature: _____

Name and Title:

Signature: _____

Name and Title:

(Any additional signatures appear on the last page)

(FOR INFORMATION ONLY – *Name, Address and Telephone*)

AGENT or BROKER:

OWNER'S REPRESENTATIVE (Architect, Engineer or other party)

1 The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, and administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2 If the Contractor performs the Construction Contract in accordance with its terms, the Surety and the Contractor shall have no obligation under this Bond.

3 Whenever the Contractor shall be declared by the Owner to be in default under the Contract, the Surety shall, at its sole expense, within 15 days after Owner having mailed to Surety a copy of the notice of default sent to Contractor, take one of the following actions:

3.1 Arrange for the Contractor, with consent of the Owner, to perform and complete the Construction Contract; or

3.2 Undertake to perform and complete the Construction Contract itself, through its agents or through independent contractors; or

3.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and the contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 5 in excess of the Balance of the Contract Price incurred by the Owner resulting from the Contractor's default; or

3.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and

.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, tender payment therefor to the Owner; or

.2 Deny liability in whole or in part and notify the Owner citing reasons therefor.

4 If the Surety does not proceed as provided in Paragraph 3, the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond,

and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Subparagraph 3.4, and the Owner refuses the payment tendered or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

5 After the Owner has terminated the Contractor's right to complete the Construction Contract, and if the Surety elects to act under Subparagraph 3.2 or 3.3 above, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract. The Surety is obligated without duplication for:

5.1 The responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

5.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 3;

5.3 Liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor, and

5.4 All other costs and damages permitted to be recovered by the Owner under the Construction Contractor at law.

6 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

7 Any proceeding, legal or equitable, under this Bond may be instituted only in the Circuit Court for Montgomery County, Maryland and the Surety waives venue in any other court.

8 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page.

9 This Bond had been furnished to comply with a statutory or other legal requirement of the State of Maryland. Any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be

construed as a statutory bond and not as a common law bond.

damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

10 DEFINITIONS

10.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for

10.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto.

10.3 Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract.

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL
Company: (Corporate Seal)

SURETY
Company: (Corporate Seal)

Signature: _____
Name and Title:
Address:

Signature: _____
Name and Title:
Address:

PAYMENT BOND

**Science West Renovation
Rockville Campus**

Use AIA Document A312, Payment Bond, A312-2010 edition, unless otherwise indicated

APPLICATION AND CERTIFICATE FOR PAYMENT

**Science West Renovation
Rockville Campus**

Use AIA Document G702, Application and Certificate for Payment, with relevant attachments, latest edition, unless otherwise indicated.

AIA G703 Continuation Sheet(s) must separately identify labor, materials and equipment costs associated with each portion of the work per specification Division.

Costs for General Conditions, Bonds, Insurance, Overhead and Profit do not need to be subdivided by portion of work, but may be reflected for the entirety of the project.

**MONTGOMERY COLLEGE
GENERAL CONDITIONS OF THE CONTRACT**

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ARTICLE 1 – GENERAL PROVISIONS**1.1. DEFINITIONS**

1.1.1. The "Agreement" is the written contract between the College and the Contractor.

1.1.2. The "College" is Montgomery Community College or Montgomery College Foundation, Inc.

1.1.3. The "Contractor" is the person or organization having a direct contractual relationship with the College for the execution of the Work under the Contract Documents.

1.1.4. The "Contract Documents" are the Agreement, the Request for Bid or Request for Proposals, Instructions for Contractors, Supplementary Instructions, the General Conditions, Supplementary Conditions, Preliminary Project Schedule, Drawings, Specifications, Addenda issued prior to execution of the Contract, Modifications issued after execution of the Contract, the Performance Bond, the Labor and Material Payment Bond, the Contractor's Bid or Proposal Form(s) and all attachments thereto received from the Contractor. The term "Contract" when used in the Specifications or Drawings shall be considered as synonymous with the term "Contract Documents".

1.1.5. The "Specifications" are the portion of the Contract Documents included in the Project Manual consisting of the written requirements for materials, equipment, construction systems, standards and workmanship for the Work, and performance of related services.

1.1.6. The "Drawings" are those enumerated in the Specifications and those incorporated in the Contract Documents as the work progresses.

1.1.7. The "Project Manual" is the volume that includes the Specifications as well as Bidding or Proposal Requirements, Contract Form, General Conditions and Supplementary Conditions.

1.1.8. The term "Work" means all of the obligations undertaken by the Contractor pursuant to the Contract Documents. Work includes, unless specifically excepted, the furnishing of all material, labor, equipment, supplies, plant, tools, scaffolding, transportation, supervision, insurance, taxes and all other services, facilities and expenses necessary for the full performance and completion of the requirements of the Contract Documents. "Work" also means that which is produced, constructed, or built pursuant to the Contract Documents.

1.1.9. The term "Project" is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the College or by separate contractors.

1.1.10. The term "Subcontractor" means any individual, partnership, firm, corporation or business entity other than an employee of the Contractor, who has a contract with the Contractor to furnish labor, or labor and materials for the Work. The term also includes Subcontractors of a Subcontractor. The term does not include vendors who furnish materials not worked to a special design according to the Drawings and Specifications.

1.1.11. The term "Site" or "Premises" means the area or areas indicated and such additional areas or locations upon which or in which Work under this Contract is being performed together with such areas adjacent thereto, as may be designated for the Contractor's use for a specified, limited period of time by the College.

1.1.12. The "Architect/Engineer" is the person commissioned by the College to design the Work and/or provide construction-phase architectural or engineering services. If the design was performed by the College, "Architect/Engineer" shall refer to the College.

1.1.13. The term "Contract Time" or "Time" and "Completion Date" is the number of calendar days (including weekends and holidays) shown in the Contract Documents as the time allowed for completion of the Work. If a calendar date of completion is shown in the Contract Documents in lieu of the number of calendar days, the Work shall be completed on or before that date.

1.1.14. The term "Contract Sum" refers to the total sum, including authorized adjustments, allotted in the Contract Documents for the services performed by the Contractor for satisfactory completion of all of the Work required by the Contract Documents.

1.1.15. "Shop Drawings" are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

1.1.16. "Product Data" are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor or a Subcontractor, manufacturer, supplier or distributor to illustrate materials or equipment for some portion of the Work.

1.1.17. "Samples" are natural materials, fabricated items, equipment, devices, appliances or parts thereof as called for in the Specifications, and any other samples as may be required by the College to determine whether the kind, quality, construction, workmanship, finish, color and other characteristics of the materials, etc., proposed by the Contractor conform to the requirements of the Contract Documents. Samples shall establish the kind, quality and other required characteristics of the various parts of the Work, and all Work shall be in accordance with the accepted samples.

1.1.18. The term "Request for Information" refers to a written instrument submitted by the Contractor requesting that a clarification with respect to the Contract Documents be provided by the Architect/Engineer.

1.1.19. The term "Change Order" refers to a written instrument signed by the College which describes a directive by the College which is a change in the Work.

1.1.20. The "College's Representative" is the Vice President of Facilities & Security or their designee.

1.1.21 The "College's Project Manager" is(are) the person(s) or entity(ies) employed or retained by the College to provide project and construction management services, including administration of the Contract as described in Article 2. The College may exercise any power or authority of the College's Project Manager under the Contract.

1.1.22. "Day" means a calendar day unless otherwise designated.

1.1.23. "Notice to Proceed" means a written notice to the Contractor of the date on which it shall begin the prosecution of the Work. The Contract Time shall begin to run from the starting date established in the Notice to Proceed. Notice to Proceed will be timely provided upon receipt of Contractor materials required before the start of work, including but not limited to performance, payment, labor and material bonds and insurance certificates.

1.1.24. "Written Notice" means giving of notice under the Contract by one party to the other. Unless otherwise indicated in the Contract Documents, Written Notice shall be deemed to have been duly served on the Contractor if delivered in person to the individual or to the member of the firm or to an office of the corporation to whom it is directed, or if delivered by regular or certified mail to the last business address known to the College. Written Notice shall be deemed to have been given to the College upon actual receipt of Written Notice by the College.

1.2. CONTRACT DOCUMENTS

1.2.1. Correlation and Intent of Contract Documents

1.2.1.1. The Contract Documents are complementary, and what is required by any one shall be as binding as if required by all. Their intent is to include in the scope of the Contract, at no additional cost to the College, all Work necessary for proper completion of the Work ready for continual efficient operation that is reasonably inferable from the Documents.

1.2.1.2. Prior to submitting its price, the Contractor shall obtain from the College, clarification of all questions which may have arisen as to the intent of the Contract Documents, or any conflict between two or more items in the Contract Documents. Should the Contractor fail to obtain clarification, then the College may direct that the Work proceed by any method indicated, specified or required by the Contract Documents, in the judgment of the College. The direction by the College shall not constitute the basis for a claim for extra costs by the Contractor. The Contractor acknowledges that it had the opportunity to request clarification prior to submitting its price to the College and that it is not entitled to claim extra costs as a result of failure to request such clarification.

1.2.1.3. The College's Project Manager shall make recommendations regarding the amount, quality, acceptability and fitness of the several kinds of Work and materials which are to be paid for under this Contract and shall make recommendations regarding all questions which may arise in relation to the Work and the construction thereof. The College's decision, based on the College's Project Manager's recommendation, shall be final and conclusive, except as herein otherwise expressly provided. In case any question shall arise between the parties relative to the Contract Documents, the determination or decision of the College shall be a condition precedent to the right of the Contractor to receive payment for the Work under the Contract related to such questions.

1.2.1.4. In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the more restrictive condition in consideration of following priorities:

- (1) Any modifications to the Contract Documents executed after the date of the Contract, with the Modifications having the latest date having the greatest authority.
- (2) The Contract.
- (3) The General Conditions.
- (4) Drawings and Specifications.

In the event of a conflict or discrepancy within the Specifications or the Drawings, or between the Drawings and the Specifications, the better quality or greater quantity of Work shall be provided in accordance with the College's interpretation.

1.2.1.5. The College's Project Manager and Architect/Engineer shall make recommendations to the College to clarify the meaning and intent of the Specifications and the Drawings where the same may be found unclear or be in dispute.

1.2.1.6. The Contractor is responsible for coordinating and completing the various parts of the Work. No part of the Work shall be left in an unfinished or incomplete condition because of a disagreement between the Contractor and Subcontractors, or between Subcontractors and the Contractor as to where the Work of one begins and ends in relation to the Work of the other. Any adjustments due to differences or conflicts which may arise between the Work of the Contractor under this Contract and the work of other contractors performing work for the College shall be determined by the College and the College's Project Manager.

1.2.1.7. Generally, the Specifications describe Work which cannot be readily indicated on the Drawings and indicate types, qualities and methods of installation of the various materials and equipment required for the Work. The Specifications are not intended to mention every item of Work which can be adequately shown on the Drawings. The Drawings are not intended to show all items of Work described or required by the Specifications even if they are of such nature that they could

have been shown thereon. All materials or labor for Work which are shown on the Drawings, or are reasonably inferable there from as being necessary to produce a finished work, shall be provided by the Contractor whether or not the Work is also expressly covered in the Specifications.

1.2.2. Specification Format

1.2.2.1. The Specifications are separated into titled sections for convenience only and not to identify the trade or craft responsible to perform the Work. The titled section shall not operate to make the College an arbitrator for the division of responsibility between Contractor and its Subcontractors, and between its Subcontractors, nor shall such sections relieve the Contractor from the responsibility for the satisfactory completion of the entire Work regardless of the division.

1.2.2.2. The General Conditions are a part of each and every section of the Specifications.

1.2.2.3. The Specifications may be abbreviated and include incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "shall be", etc., are intentional; nevertheless, the requirements of the Specifications are mandatory. Omitted words or phrases shall be supplied by inference in the same manner, as they are when a "note" occurs on the Drawings.

1.2.2.4. Words in the singular shall include the plural whenever applicable, or the context so indicates.

1.2.2.5. Where "as shown", "as indicated", "as detailed" or words of similar import are used, reference is made to the Drawings accompanying the Specifications unless otherwise stated. Where "as directed", "as required", "as permitted", "as authorized", "as approved", "as accepted", "as selected", or words of similar import are used, the direction, requirement, permission, authorization, approval, acceptance or selection by the College is intended unless otherwise stated. As used herein, "provide" means "provided complete in place", that is, furnished and installed and ready for operation and/or use.

1.2.3. Standard Specifications

1.2.3.1. Any reference to standard specifications of any society, institute, association or governmental authority is a reference to the standard specifications of such organization and to their methods of installation of the various materials and equipment required for the Work which are in effect at the time prices are due. It is not intended to mention every item of work described or required by the standard specifications even if they are of such nature that they could have been shown thereon. All materials or labor for work which are inferable there from, as the Contractor shall provide being necessary to produce a finished job at the date of the Contractor's price. If such specifications are revised prior to completion of any part of the work to which such revision would pertain, the Contractor may, if acceptable to the College, perform such work in accordance with the revised specifications.

1.2.3.2. The standard specifications, except as modified in the Specifications for the Project, shall have full force and effect as though printed in the Specifications.

1.2.4. Ownership

1.2.4.1. The Drawings, Specifications and other documents prepared by the Architect/Engineer, are owned by the College. Copies thereof furnished to the Contractor, are for use solely with respect to this Project.

ARTICLE 2 – COLLEGE

2.1. AUTHORITY OF COLLEGE'S PROJECT MANAGER

2.1.1. The College's Project Manager has the authority to perform all of the College's functions pertaining to the conduct and administration of the work, except as indicated in 2.1.2.

2.1.2. Unless otherwise indicated in the contract documents, the College's Project Manager is NOT authorized to make determinations (as opposed to recommendations) that:

- 2.1.2.1. Alter or modify the Contract Documents;
- 2.1.2.2. Alter the contract schedule;
- 2.1.2.3. Approve contract change orders;
- 2.1.2.4. Terminate or cancel the contracts.

2.1.3. Unless otherwise indicated in the contract documents, recommendations made by the College's Project Manager, pertaining to determinations listed in 2.1.2, are changes in the work that require review, approval and further authorizing action from the College as indicated in Article 6.

2.2. RESPONSIBILITIES OF THE COLLEGE'S PROJECT MANAGER

2.2.1. The College's Project Manager shall be an agent of the College to the extent set forth in the Contract Documents. Any non-College employee in such role shall not be deemed to be the employee of the College for any purpose in connection therewith. The College's Project Manager shall have full authority to act, or to cause others to act, on behalf of the College to assure that the Work is carried out in full compliance with the requirements of the Contract, and to otherwise generally protect the College's interests.

2.2.2. The College's Project Manager will determine in general that the Work of the Contractor is being performed in accordance with the Contract Documents, and will use his best efforts to guard the College against defects and deficiencies in the Work of the Contractor.

2.2.3. The College's Project Manager shall provide administrative management and related services as required to coordinate the Work of the Contractor and separate contractors with each other and with the activities of the Architect/Engineer to complete the Project in accordance with the College's objectives for cost, time and quality.

2.3. RESPONSIBILITIES OF THE ARCHITECT/ENGINEER

2.3.1. Architect/Engineer's Status

2.3.1.1. The College may maintain staff personnel from the Office of Central Facilities, or as separate architectural and/or engineering services retained by the College, at the site of the Work for field observation and day-to-day monitoring of the Work.

2.3.1.2. The Architect/Engineer shall assist the College during the construction period and with the College's Project Manager shall observe the Work in process on behalf of the College. The Architect/Engineer will not be responsible for construction means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work. The Architect/Engineer shall have authority to act on behalf of the College only to the extent expressly provided in the Contract Documents or otherwise in writing.

2.3.1.3. With the College's Project Manager the Architect/Engineer may advise the College with respect to claims of the College or the Contractor, on matters relating to the execution and progress of the Work and on the interpretation of the Contract Documents.

2.3.1.4. Together with the College's Project Manager the Architect/Engineer shall certify applications for progress payments and final payment that the Contractor has complied with the requirements of the Contract Documents.

2.3.1.5. Together with the College's Project Manager the Architect/Engineer shall determine Contractor's achievement of Substantial Completion and Final Completion milestones, and issue relevant certificates, in accordance with the requirements of the Contract Documents.

2.4. COLLEGE'S RIGHT TO STOP OR SUSPEND WORK

2.4.1. Stopping of the Work

2.4.1.1. Subject to concurrence by the College, the College's Project Manager may stop all or part of the Contractor's Work, if in the opinion of the College's Project Manager the Contractor has performed Work not in conformance with the Contract Documents. The Work may be stopped until such time that the defective conditions have been corrected. All costs related to the stoppage of the Work shall be borne by the Contractor.

2.4.2. Suspension of the Work

2.4.2.1. The College unilaterally may order the Contractor in writing to suspend, delay or interrupt all or any part of the Work for a period of time as it may determine to be appropriate.

2.4.2.2. If the performance of all or any part of the Work is for an unreasonable period of time suspended, delayed or interrupted by an act or omission of the College in the administration of the Contract, an adjustment shall be made for any increase in the cost of performance of the Contract (excluding profit) necessarily caused by an unreasonable suspension, delay or interruption and the Contract modified in writing accordingly. No adjustment shall be made under this subsection for any suspension, delay or interruption to the extent (1) that performance would have been so suspended, delayed or interrupted by any other cause, including the fault or negligence of the Contractor; or (2) for which an equitable adjustment is provided for or excluded under any other provision in this Contract.

ARTICLE 3 – CONTRACTOR

3.1. RESPONSIBILITIES OF THE CONTRACTOR

3.1.1. The Contractor shall furnish all labor, materials, equipment, tools, construction equipment, machinery, plant, supplies, utilities, telephone, transportation, supervision, temporary construction, permits, insurance, taxes, bonds, contributions and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work, as described in the Contract Documents.

3.1.2. Montgomery County or City of Rockville Complex Structures processes may apply to the project. When applicable, Contractor shall fulfill any necessary obligations related to that process.

3.2. CONTRACTOR'S ADMINISTRATION AND SUPERVISION OF THE WORK

3.2.1. Staff

3.2.1.1. The Contractor shall furnish a competent, qualified and adequate staff as necessary to administer coordinate, supervise and superintend the Work; to organize the procurement of all materials and equipment so that they will be available at the time they are needed for the Work; and to keep an adequate force of skilled workers on the job to complete the Work in accordance with all requirements of the Contract Documents and to the entire satisfaction of the College's Project Manager. Key members of the staff shall not be changed without the consent of the College's Project Manager.

3.2.1.2. Prior to commencement of the Work, the Contractor shall select a project representative who will have full responsibility for the prosecution of the Work, with full authority to act in all matters as necessary for the proper coordination, direction and technical administration of the Work and who shall attend meetings at such place or places as determined by the College's Project Manager in order to render reports on the progress of the Work.

3.2.2. Supervision

3.2.2.1. The Contractor shall efficiently supervise the Work, using its best skill and attention. It shall carefully study and compare all drawings, specifications and other instructions and shall at once report to the College's Project Manager any error or omission which it may discover, and shall subsequently proceed with the Work in accordance with instructions from the College's Project Manager concerning such error or omission.

3.2.2.2. The Contractor shall assign to the job throughout its duration a well-qualified, competent superintendent and any necessary assistants, all of whom must be satisfactory to the College's Project Manager. The superintendent shall represent the Contractor in its absence and all directions given to him shall be as binding as if given to the Contractor. Important directions shall be confirmed in writing to the Contractor. Other directions shall be so confirmed on written request in each case.

3.2.2.3. The College's Project Manager shall not supervise the Work. The means, methods, techniques, sequences, procedures and safety measures utilized in the performance of the Work are the sole responsibility of the Contractor, subject to overall coordination of the College's Project Manager. Any means, method, techniques, sequences or procedures set forth in the Contract Documents are solely to specify the desired end product; and if the means, methods, techniques, sequences or procedures will not result in the desired end product or is unsafe or illegal because of some inherent defect in the Specifications or the particular conditions under which the Work is being performed, it is the Contractor's responsibility to select a correct means, method, technique, sequence or procedure. Nothing in the College's Project Manager's review of the general quality and progress of the Work, including acceptance of submittals and Work, shall be construed as the assumption of authority or supervision over the performance of the Work.

3.2.3 Subcontracts

3.2.3.1. The Contractor shall, prior to the execution of the Contract, notify the College in writing of the names of Subcontractors, if any, proposed for the principal parts of the Work and for such other parts of the Work as the College's Project Manager may direct. The Contractor shall not employ any Subcontractor that the College may, within a reasonable time, object to for any reason.

3.2.3.2. The Contractor is as fully responsible to the College for the performance, management, acts and omissions of its Subcontractors and of persons either directly or indirectly employed by them, as it is for the performance, management, acts and omissions of persons directly employed by it.

3.2.3.3. Nothing contained in the Contract Documents shall create any contractual obligation between any Subcontractor and the College.

3.2.3.4. The Contractor agrees to bind every Subcontractor, and every Subcontractor agrees to be bound by the terms of the Contract, the Drawings and the Specifications as far as applicable to its Work, including the following provisions, unless specifically noted to the contrary in a subcontract approved in writing as adequate by the College.

3.2.3.5. The Subcontractor agrees:

- (1) To be bound to the Contractor by the terms of the Contract, the Drawings and the Specifications, and to assume toward the Contractor all the obligations and responsibilities that it, by those documents, assumes toward the College.
- (2) To submit to the Contractor applications for payment in such reasonable time as to enable the Contractor to apply for payment.

3.2.3.6. The Contractor agrees to place in its subcontracts with Subcontractors:

- (1) To be bound to the Subcontractor by all the obligations that the College assumes to the Contractor under the Contract, the Drawings and the Specifications, and by all the provisions thereof affording remedies and redress to the Contractor from the College.
- (2) To pay the Subcontractor, upon the payment of certificates, if listed in the Schedule of Values the amount allowed to the Contractor on account of the Subcontractor's Work to the extent of the Subcontractor's interest therein.
- (3) To make no demand for liquidated damages for delay in any sum in excess of such amount as may be specifically named in the subcontract.
- (4) That no claims for services rendered or materials furnished by the Contractor to the Subcontractor shall be valid unless written notice thereof is given by the Contractor to the Subcontractor during the first ten days of the calendar month following that in which the claim originated.
- (5) To give to the Subcontractor an opportunity to be present and to submit evidence in any decision involving its rights.

3.2.4. Behavior of Contractor's Employees, Agents and Subcontractors

3.2.4.1. The College is committed to providing a work and study environment that is free from discrimination and harassment on the basis of race, color, religious creed, ancestry, national origin, age, sex, marital status, handicap, pregnancy or status as a disabled veteran or veteran of the Vietnam Era. Behavior contrary to this philosophy, which has the purpose or effect of creating an intimidating, hostile, or offensive environment, will not be tolerated by the College, and it is the Contractor's responsibility to ensure that such behavior by its employees, agents and subcontractors does not occur.

3.2.4.2. This policy extends to maintaining an environment free from sexual harassment. Therefore, sexual advances, sexual remarks, requests for sexual favors, and other verbal or physical conduct of a sexual nature must not be condoned or permitted by the Contractor. This prohibition extends to such harassment within the employment context as well as harassment of students, staff and visitors

of the College. It should be assumed that all sexual behaviors by the Contractor's employees, agents or subcontractors on any campus or facility of the College, whether owned, operated, maintained or leased by the College, is improper and unwelcome.

3.2.4.3. Montgomery College is a tobacco free institution. Use of tobacco products is prohibited in all indoor and outdoor College-owned facilities and facilities leased and controlled by the College as well as at meetings or conferences sponsored by the College. This use prohibition extends to Contractors' employees, agents, subcontractors and vendors.

3.3. MATERIALS, LABOR, EQUIPMENT AND PROCESSES

3.3.1. Proposals

3.3.1.1. Proposals shall be based upon the materials, equipment or processes specifically named, implied in or reasonably inferable from the Contract Documents.

3.3.1.2. In cases where work is to be performed in an existing building, proposals shall be based on Contractor's review of existing conditions by means including but not limited to: site inspection and review of existing College documentation, if any, including data from the Environmental Safety Office. Failure or omission of the Contractor to inspect the site and examine available documents shall in no way relieve the Contractor from obligations with respect to his price, nor constitute grounds for a subsequent claim.

3.3.1.3. Certain project proposals shall be based on Prevailing Wage Rate schedule provided by and the reporting requirements of the State of Maryland's Department of Labor, Licensing and Regulation (DLLR). If guidance regarding applicability of Prevailing Wage Rates is not otherwise included in the Contract Documents, Contractor shall request a determination of applicability from the College prior to submitting a proposal.

3.3.2. Labor, Materials and Equipment

3.3.2.1. The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract.

3.3.2.2. The Contractor shall furnish sufficient forces to ensure the prosecution of the Work within the time stated in the Contract.

3.3.2.3. The Contractor shall comply with the provisions of Sections 17208 entitled Prevailing Wage Rates, when applicable, and 17301 through and including 17306 of the State Finance and Procurement Article of the Annotated Code of Maryland (as amended from time to time) entitled "Steel Procurement for Public Works."

3.3.2.4. Unless otherwise specified, all materials and equipment to be permanently installed in the Work shall be new, and shall be of such quality as required to satisfy the standards of the Contract Documents. The Contractor shall, if required, furnish satisfactory evidence as to kind and quality of all materials and equipment.

3.3.2.5. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them. All labor shall be performed by workers skilled in their respective trades, and work produced shall be of good quality so that first class work in accordance with the standards of construction set forth in the Contract Documents will result.

3.3.3. Use of Named Materials

3.3.3.1. Where materials are specified by a name, or several names are specified, without the words 'or equal' following such name(s) the Contractor shall use and/or supply the named material that meets all the requirements of the Specifications.

3.3.4. Use of Equivalent Materials

3.3.4.1. Where the words 'or equal' are included, at the Contractor's sole risk, the Contractor may submit a material it considers to be equal in quality, capacity, size, or other determining criteria. The burden of submitting adequate information to the College to prove equality of materials shall be the responsibility of the Contractor. A direct comparison of features and fit with the specified item must be included. Whether an equal or specified product is proposed, all of the units of a given type required for and used in the Work must be the same in material and manufacture. The decision of the College with regard to quality of materials shall be final. The College may reject a proposed equal without cause and the Contractor shall not be entitled to additional compensation.

3.3.5. Substitutions

3.3.5.1. Substitutions requests will be considered only under the following circumstances:

- (1) When the specified product is not available; or
- (2) When, if a certain product or process is specified and a guarantee of performance is required and, in the judgment of the Contractor, the specified product or process will not produce the desired results; or
- (3) When a substitution, in the opinion of the College is in its best interest.

3.3.5.2. Requests for substitutions of products, materials or processes other than those specified shall be submitted in writing to the College's Project Manager and be accompanied by evidence that the proposed substitution: (1) is equal in quality and service-ability to the specified item; (2) will not entail changes in details and construction of related work; and (3) will be acceptable in consideration of the required design and artistic effect. The Contractor will furnish with his request such drawings, specifications, samples, performance data and other information as may be required of it to assist the College in determining whether the proposed substitution is acceptable. A direct comparison of features and fit with the specified item must be included. The substitution request shall state the credit or extra, if any, involved with the use of such material. The burden of proof shall be upon the Contractor.

3.3.5.3. Regardless of the evidence submitted or any review or independent investigation by the College, a request for a substitution of products, materials or processes is a warranty by the Contractor to the College that (1) the requested substitution is equal in quality and serviceability to the specific item; (2) will not entail changes in details and construction of related work; (3) will be acceptable in consideration of the required design and artistic effect; (4) will not involve any additional cost to the College other than that specified in an accompanying request for a change order; and (5) the Contractor will provide the same or better warranty for the substitution that the Contractor would for that specified.

3.3.5.4. The College's acceptance of a substitution does not relieve the Contractor of responsibility for any unforeseen consequences and/or costs associated with the substitution.

3.3.5.5. The College may reject a proposed substitution without cause.

3.3.6. Required List of Materials and Equipment

3.3.6.1. Unless otherwise indicated in the Contract Documents, the Contractor shall submit to the College's Project Manager a comprehensive list of the manufacturer's products proposed for this Work as soon as practicable and within thirty (30) calendar days after receipt of notice to proceed.

The list shall include information on materials, equipment and fixtures as may be required for the College's Project Manager's preliminary review; partial lists will not be considered. Acceptance of this list of products shall not be construed as a substitute for the shop drawings, manufacturer's descriptive data and samples which are required by the Contract Documents, but rather as a base from which more detailed submittals shall be developed for the College's final review.

3.4. WARRANTY/GUARANTEES

3.4.1. Except to the extent that the Contract Documents impose greater warranty obligations on the Contractor for all or any part of the Work, the Contractor warrants:

3.4.1.1. that the materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents;

3.4.1.2. that the Work contains no faulty or imperfect material or equipment or any imperfect, careless or unskilled workmanship;

3.4.1.3. that all mechanical and electrical equipment, machines, devices, etc., shall be adequate for the use to which they are intended and shall operate with ordinary care and attention in a satisfactory and efficient manner; and

3.4.1.4. that the entire Work shall be watertight and leak proof in every particular.

3.4.1.5. Unless otherwise indicated in the Contract Documents, for a period of one year commencing on the date of Substantial Completion or such other date agreed upon, the Contractor shall schedule, manage and monitor all warranty call-backs requested by the College and re-execute, correct, repair, or remove and replace with proper Work, without cost to the College, any Work found not to be as guaranteed by this section or otherwise not in conformity with the Contract and that it will make good all damages or cost to other Work or materials in the process of complying with this section in accordance with Article 10, Correction of Work. The Contractor shall pay for tests and inspections made necessary by faulty Work. The correction period shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. This obligation shall survive Final Completion of the Work under the Contract and the Contract Close Out.

3.4.2. Nothing contained in Subsection 3.4.1.5 shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of time period of one year as described in Subsection 3.4.1.5 relates only to the specific obligation of the Contractor to correct the Work and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

3.4.3. The Contractor shall cause to be assigned to the College all warranties/guarantees furnished by manufacturers and suppliers of equipment and supplies for the Work. The assignment shall not affect Contractor's warranty obligations to the College.

3.5. TAXES

3.5.1. The College is not exempt from payment of Maryland State Sales Tax and Municipal Occupation (Sales) and/or Use Taxes on materials purchased for this Work.

3.5.2. The Contractor and Subcontractors shall pay sales, consumer, use, unemployment, old age pension and/or other taxes imposed by local, state and/or the Federal government, except taxes and assessments on the real property comprising the Work site. The Contractor is to include such expenses in its proposal.

3.6. PERMITS AND LICENSES

3.6.1. The College will file for the building permit, if one is necessary, with the local authority. The Contractor shall obtain and pay for any and all permits (other than the building permit), and for all licenses and certificates of inspection necessary for the execution and completion of the Work as called for in the Contract Documents. The Contractor will be required to pay all necessary fees to local authorities for permits and inspections and it shall include the cost of the fees in its base price. The College shall not be responsible for the actions or interpretations of county, municipal or other local agencies or officials with respect to the application of Federal, State or local laws, rules, ordinances, regulations, codes or policies to the Work.

3.6.2. The Contractor must be licensed as required by Title XVII, Subtitle VI or Title VIII of the Business Regulation Article, Annotated Code of Maryland.

3.7. PROSECUTION AND PROGRESS OF THE WORK

3.7.1. Notice to Proceed

3.7.1.1. After the Contract has been executed, the College's Project Manager will issue to the Contractor a "Notice to Proceed" and this notice will stipulate the date on or before which the Contractor is expected to begin Work. The specified contract time shall begin on the starting date stated in the "Notice to Proceed." Any Work started or materials ordered before the starting date stated in the "Notice to Proceed" shall be at the risk of the Contractor.

3.7.1.2. Notice to Proceed will be timely provided upon receipt of Contractor materials required before the start of work, including but not limited to performance, payment, labor and material bonds and insurance certificates. The Contractor is prohibited from performing any Work on the site until proof of the insurance required by the Contract is provided to the College.

3.7.2. Hours of Work

3.7.2.1. The Work shall be performed during regular working hours except in the event of emergency, or when required to complete the Work within the time stated in the Contract. What constitutes regular working hours will be agreed upon at the preconstruction conference.

3.7.2.2. The Work shall be suspended on the College's Commencement Day (typically the third Friday in May) unless otherwise agreed to by the College.

3.7.2.3. The Work may be performed on night shifts, overtime, Sundays and holidays when permission to do so has been obtained from the College, at no additional cost to the College, and provided that Contractor complies with any additional regulations regarding off-hours work mandated by regulatory authorities.

3.7.3. Construction Schedule

3.7.3.1. Time

- (1) All time limits in the Contract Documents are of the essence of the Contract. Contractor and the College agree that the time stated in the Contract for the completion of the Work is a reasonable time, considering the usual climatic range and the usual business conditions prevailing in the locality of the project. The Contract time shall be the full time allowed or required for completion of every task involved in completion of the Work, including lead-time for ordering and fabrication of equipment and materials.
- (2) The College is not obligated (a) to accept an early completion schedule from the Contractor, or (b) to accept the project prior to the completion date stated in the Contract. The College will not be liable for any claims based on the Contractor's assertion of an intention to finish early.

3.7.3.2. Preliminary Schedule

- (1) The Contractor shall agree to comply with the Preliminary Project Schedule prepared by the College and included in the Contract Documents or with the Contractor's Proposed Project Schedule, if one was required as part of the Contractor's proposal submission. Agreement by the Contractor to comply with the Preliminary Project Schedule or Contractor's Proposed Project Schedule also means agreement by the Contractor to comply with subsequent reasonable updates prepared or requested by the College.
- (2) Within 14 days of the execution of the Contract, Contractor must submit for approval, preliminary schedule information outlining all activities for the Contractor's work as may be reasonably requested by the College's Project Manager. Coordinate schedule information with milestones indicated in the Preliminary Project Schedule. This preliminary information must be approved prior to the first Application for Payment being processed. Include each significant construction activity, coordinate each activity with other activities and schedule each construction activity in proper sequence. The College's Project Manager may decline to issue a Notice to Proceed until Contractor has submitted the required schedule information and it is approved by the College's Project Manager. Nothing in this section shall be construed to require the College's Project Manager to issue a Notice to Proceed when the required schedule information has been submitted and approved.
- (3) With submission of the preliminary schedule information, include a listing by date of submission of all submittals required. Identify those required to maintain orderly progress of the Work, and those required early because of long lead time for manufacture or fabrication.

3.7.3.3. Completion Schedule

- (1) Within 30 days after Contract execution and at such other times as required by subsections 3.7.3.4 and 3.7.3.8, the Contractor shall submit for approval, updated schedule information indicating the time allocated by the Contractor for the performance of each portion of the Work and the submittal information required by subsection 3.7.3.2 (3), properly and reasonably sequenced for achieving each task shown on the schedule. Coordinate schedule with milestones indicated in the Preliminary Project Schedule.
- (2) The Contractor's construction schedule shall begin with the date of issuance of Notice to Proceed and conclude with the required date of final completion of the project as stated in the Contract Documents. Float or slack time available in the schedule at any time shall not be for the exclusive use or benefit of either the Contractor or the College, but is jointly owned.
- (3) The Contractor's schedule information shall include a complete itemized breakdown of the Work, listed by activity or event number, including items related to the General Conditions, all necessary dates for submittal, review and response, and re-submittal (if necessary), and for each activity shall show at a minimum: (1) a sequence of operations; (2) the dates of commencement and completion of each item of the Work; and (3) delivery for material and equipment. Unless otherwise indicated in the Contract Documents or agreed upon by the College's Project Manager the duration of each activity shall be twenty-one calendar days or less.
- (4) Contractor shall submit with each Application for Payment revised schedule information accurately updated to reflect all: (1) revisions to the schedule (2) changes made or planned in the construction sequence; (3) actual construction activities to date including (i) commencement and completion dates for activities started or completed during the reporting period; and (ii) current progress of activities started in prior reporting periods including completion dates for activities completed during the reporting period; (4) delays and their effects on the critical path; (5) extensions of time granted by the College and (6) the Contractor's planned schedule or recovery schedule for completing remaining activities. This required schedule information update shall be furnished monthly whether or not Contractor submits an application for payment in that month.
- (5) In the event that change orders are experienced, they shall be reflected as new activities, or as changes in logic and/or time framing of existing activities. They shall be introduced

- at the next updating after receipt of a change order, and shall be subject to the approval of the College's Project Manager. Change order logic shall affect only those intermediate activities and performance dates directly concerned. Adjustments required in completion dates for those intermediate dates, or for the contract as a whole, will be considered only to the extent that there is not sufficient remaining float to absorb the additional time which may be authorized for completion of individual activities.
- (6) Whenever the project shall be behind schedule or alleged by either party to be behind schedule, the College may require the Contractor to furnish, at no additional cost to the College revised schedule information (hereinafter called a "recovery schedule") showing how the Contractor will finish their work by the Contract completion date.
 - (7) All of Contractor's schedule information, including monthly schedule information updates and any recovery schedule information required shall be subject to review and approval by the College's Project Manager.
 - (8) The Contractor shall cooperate with the College's Project Manager in scheduling and performing the Contractor's Work to avoid conflict, delay in or interference with the Work of other contractors or the construction or operation of College's own forces. The Contractor shall participate with other contractors and the College's Project Manager and College in reviewing schedules when directed to do so. The Contractor shall make any revisions to their construction schedule information deemed necessary after a joint review.
 - (9) Approval by the College's Project Manager of any schedule information submitted shall constitute approval of the schedule information only for general conformity with Contract requirements and shall not constitute approval, acceptance or admission of the reasonableness, accuracy, achievability, or feasibility of the schedule information or of the Contractor's ability to meet the schedule, or waiver or excuse of default or delay by the Contractor, extension of the time for completion, waiver or modification of Contract requirements, admission of fault or responsibility for delay on the part of the College or acceptance or admission on the part of the College of any liability or responsibility for the schedule or for acceleration or other costs or delay damages of the Contractor which are inferable from the Contractor's schedule information or update.
 - (10) The College is not obligated to pay the Contractor for Work completed until proper, accurate schedule information, and updates are furnished as required and it is not liable for and Contractor is not entitled to damages, compensation, or time extensions for delays starting, occurring or continuing during the period when an accurate and reasonable schedule information or update was due but not furnished by the Contractor.

3.7.3.4. All schedule information, including initial schedule information, recovery schedule information and monthly updates, shall be submitted in three (3) paper copies and one (1) electronic copy in Portable Document Format (PDF), unless otherwise indicated.

3.7.4. Progress Meetings

3.7.4.1. Contractor shall plan and participate in routine project progress meetings to brief College's Project Manager and Architect/Engineer on the status of the project. Frequency of meetings shall be determined at a preconstruction conference, but shall typically occur not less than every two weeks. Primary agenda topics shall include reporting status of: Regulatory Approvals, Submittals, RFI's, Commissioning, Safety, Security and Housekeeping, Schedule, Contracts/Finance and Close-Out. Unless otherwise indicated in the Contract Documents, record meeting minutes will be prepared by the College's Project Manager.

3.7.4.2. Contractor shall provide reasonable advance notice to the College's Project Manager and Architect/Engineer regarding scheduling of pre-construction and pre-installation conferences with subcontractors. At a minimum, Contractor should anticipate College's participation in conferences related to underground work, demolition work, primary structural work, all building enclosure work, MEP and telecommunications, AV and security systems work.

3.7.5. Progress Meeting Documentation and Reports

3.7.5.1. Contractor shall prepare, maintain, monitor and make available to the College, reasonable project progress documentation including, but not limited to:

- (1) Contractor's Daily Reports: listing weather conditions, trades on site, manpower, brief description of activities underway, quality control issues raised, commissioning activities underway and any safety or security issues encountered. Append Daily Reports from Subcontractors to the Contractor's Daily Report.
- (2) Minutes from Pre-Construction and Pre-Installation conferences.
- (3) Minutes from Contractor's Subcontractor and/or Foreman's meetings: including agenda topics, brief summary of issues discussed resolutions discussed and issues requiring attention.
- (4) Inspection reports provided by Independent Testing Agencies and/or Laboratories, when applicable.
- (5) Inspection reports provided by any authorities having jurisdiction on the project.

3.8. REFERENCE DOCUMENTS FOR THE WORK

3.8.1. Conformance Documents

3.8.1.1. The College may issue conformance documents, incorporating all Addenda issued during the bid/proposal period into the Contract Documents, for the Contractor's convenience at the start of Work. It is the Contractor's sole responsibility to verify the accuracy of the conformance documents. At the Contractor's election, conformance documents may serve as the basis for Progress Documents. Use of such documentation shall not in any way relieve the contractor from its responsibility to perform the Work in accordance with the Contract Documents. In the event of a discrepancy between the conformance documents and the Contract Documents, the Contract Documents shall govern.

3.8.2. Progress Documents

3.8.2.1. The Contractor shall keep one complete set of all Drawings, Specifications, construction progress schedule, and shop drawings at the job-site current and in good order. As the Work progresses, the Contractor shall keep a complete and accurate record of all changes or deviations from the Contract Documents, indicating the Work as actually installed. All underground utility locations associated with the scope of work, or revealed during the conduct of the work, shall be recorded by the Contractor's surveyor and referenced to a campus benchmark provided by the College. All such changes shall be neatly and correctly shown on black line prints of the drawings affected, or in the Specifications, with appropriate supplementary notes. This record set of prints of Drawings, shop drawings and Specifications shall be kept at the job site for inspection by the College's Project Manager and Architect/Engineer.

3.8.3. Record Documents

3.8.3.1. At the completion of the Work, the Contractor shall certify by endorsement thereof, that each of the revised prints of the Drawings and Specifications is complete and accurate. Prior to the Contractor's application for final payment, and as a condition to its approval by the College, the Contractor shall assemble its record drawings and specifications, review them for completeness and submit them to the College's Project Manager. The Contractor shall provide suitable transfer cases and deliver the records therein, indexed and marked for each division of the Work.

3.8.3.2. No review or receipt of such records by the College's Project Manager shall be a waiver of any deviation from the Contract Documents or the shop drawings or in any way relieve the Contractor from its responsibility to perform the Work in accordance with the Contract Documents and the shop drawings to the extent they are in accordance with the Contract Documents.

3.9. SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.9.1. After checking and verifying all field measurements and after complying with applicable procedures specified in the Contract Documents, Contractor shall submit to the College's Project Manager and Architect/Engineer, in accordance with the Contractor's schedule, shop drawings and other submittals which will bear a stamp or specific written indication that the Contractor has satisfied its responsibility under the Contract Documents with respect to the review of such submissions. The data on the shop drawing or submittal must be complete with respect to quantities, dimensions, specified performance and/or design criteria, materials and similar data to enable the Architect/Engineer to review the information as required. These documents shall be prepared in conformity with the best practice and standards for the trade concerned. Due regard shall be given to speed and economy of fabrication and erection.

3.9.2. Obtaining electronic documentation to aid in the preparation of shop drawing submittals shall be the sole responsibility of the Contractor and may be subject to certain terms and conditions required by the Architect/Engineer and/or College. The College cannot guarantee that electronic documentation prepared by the Architect/Engineer will be made available to the Contractor. If provided, Contractor shall not be entitled to rely on such documentation for accuracy and use of such documentation shall not in any way relieve the Contractor from its responsibility to perform the Work in accordance with the Contract Documents.

3.9.3. The Contractor shall prepare and routinely update a submittal log indicating the status of submittals.

3.9.4. Unless otherwise indicated in the Contract Documents or agreed to by the College in writing, the Contractor shall send the College one copy of all shop drawings and product data coincident with the initial and any subsequent submissions to the Architect/Engineer. The College will forward any comments it desires to make to the Architect/Engineer within the designated review time.

3.9.5. In addition to the items noted in the Specifications as requiring shop drawings or other details, shop drawings and details shall be required for all items which are specifically fabricated for the Work or when the assembly of several items is required for a working unit.

3.9.6. The College's Project Manager and Architect/Engineer will examine the shop drawings and product data submittals with reasonable promptness. The College's Project Manager and Architect/Engineer will note whether they are approved, approved with corrections and/or conditions, or rejected. The Architect/Engineer will return the shop drawings and project data submittals with the final action to the Contractor and also provide one copy each to the College and College's Project Manager.

3.9.7. The Contractor must allow the Architect/Engineer, College's Project Manager at least fourteen calendar days following receipt of each submittal or re-submittal of shop drawings and product data submittals to review the documents and respond to the Contractor. Items requiring longer than fourteen calendar days of review time will be identified in the Specifications. The minimum time allowed for the Architect/Engineer, College's Project Manager to review the submittal shall be increased to the extent that additional time for review is needed due to the fault or the responsibility of the Contractor or its Subcontractors and suppliers. The Contractor will be notified of the cause of the delay and advised of how long it will take to complete the review; provided, however, that mere failure to give the Contractor such notice shall not entitle the Contractor to compensation or a time extension.

3.9.8. When the Architect/Engineer, College's Project Manager or the College desires corrections, or rejects the drawings, the Contractor shall resubmit the drawings with the required corrections in a timely manner.

3.9.9. Unless the Contractor has, in writing, at the time of the submissions, expressly notified the Architect/Engineer, College's Project Manager and the College to the contrary, the College and the Architect/Engineer may assume that shop drawings and other submittals from the Contractor are in

conformity with the Contract Documents and do not involve any change in the Contract price, or any change which will alter the space within the structure, or alter the nature of the building or Work from that contemplated by the Contract Documents, or constitute a substitution of material or equipment or a change in the Contract or the scope of Work. If the Contractor fails to give notice strictly in accordance with this subsection, approval of any shop drawing or submittal shall not be binding on the College.

3.9.10. The Contractor shall perform no portion of the Work requiring submittal and review of shop drawings, product data, samples and similar submittals until the respective submittal has been approved by the Architect/Engineer. Such Work shall be in accordance with accepted submittals. Work performed without approval shall be at the Contractor's risk.

3.9.11. Shop drawings, product data, samples and similar submittals shall be marked, tagged, or otherwise properly identified with the name of the Contractor, the name of the project, the purpose for which the samples are submitted, and the date and shall be accompanied by a letter of transmittal containing similar information, together with the Specification section number for identification of each item. Each tag or sticker shall have clear space for the stamps of the Contractor, College's Project Manager and the Architect/Engineer.

3.9.12. Samples of materials which are generally furnished in containers bearing the manufacturers' descriptive labels and printed application instructions shall, if not submitted in the standard containers, be supplied with such labels and application standards.

3.9.13. Should the Contractor consider any rejection or notation on the shop drawings or other submittals by the College's Project Manager or Architect/Engineer or any other action or inaction of the College's Project Manager or the Architect/Engineer to cause a change in the scope of the Work from that required by the Contract Documents, whether or not such change may affect contract price or time, then the Contractor shall desist from further action relative to the item in question and shall in writing (1) immediately notify the Architect/Engineer, the College and College's Project Manager requesting clarification; and (2) furnish them, within seven (7) days, with a notice explaining the nature of the change and whether increased or decreased cost and/or time is anticipated. No Work shall be executed until the entire matter is clarified and the Contractor is ordered by the College to proceed. Failure of the Contractor to serve written notice as required above shall constitute a waiver of any claim in relation thereto.

3.10. SITE INFORMATION, ACCESS, USE AND RESTRICTIONS

3.10.1. Site Information

3.10.1.1. Contractor shall review existing conditions and related College record information to become completely familiar with site and adjacent conditions. Contractor shall make arrangements to review available documentation and undertake explanatory site visits with College's Project Manager and Campus Facilities Office.

3.10.2. Campus Coordination Requirements

3.10.2.1. Contractor shall furnish a Site Mobilization Plan to the College's Project Manager for review and approval prior to the start of Work. Plan shall indicate features including proposed Construction Delivery route, Materials and Trash Storage Areas, Site Office and Toilet Facility locations, Fencing, Erosion Control Measures, Tree and Plant Protection, Temporary Lighting, Temporary Traffic Control Measures and Signage.

3.10.2.2. Contractor shall meet with Campus Facilities and Security Offices prior to the start of Work to review Contractor's proposed Site Mobilization Plan, and to coordinate project needs with Campus Operations and Maintenance, House and Grounds-keeping and Security operations.

3.10.2.3. In the event that Contractor's operations affect or disrupt campus access roads and/or building entrances or exits, Contractor shall coordinate maintaining or re-directing access in accordance with the contract documents and following the direction and policies of the Campus Security Office and any affected emergency service providers.

3.10.2.4. Contractor shall meet with College's Environmental Safety Office prior to the start of Work for projects where Hazardous Materials Abatement or use of Hazardous or Toxic Substances is expected.

3.10.2.5. Any Utility shut down required must be scheduled with relevant utility Owner and Campus Facilities at least 5 days in advance.

3.10.2.6. Unless otherwise indicated in the Contract Documents, vehicular and pedestrian access to properties shall be maintained operational to the maximum possible extent. Driveways to private properties shall not be blocked. Sidewalks and crossings shall be kept open for the passage of pedestrians. Streets shall not be unnecessarily obstructed and, unless the College shall authorize the complete closing of a street, the Contractor shall take such measures as may be necessary to keep the street open for traffic. The Contractor shall provide and maintain suitable and sufficient provisions, including but not limited to flag persons, barricades, warning signs and detour signs, necessary for the protection of the work and safety of the public. All barricades, obstructions and signage shall be illuminated from sunset to sunrise, daily.

3.10.2.7. Parking at all campus locations is limited. Other than one or two spaces for supervisory personnel, parking space for construction site personnel in campus parking lots should not be anticipated. For projects where work is confined within a site construction fence, Contractor may provide limited parking for construction personnel within that fenced area as long as parking does not impede progress of the work or impede access by emergency or campus service vehicles.

3.10.3. Coordination where Work is in or adjacent to an Occupied Existing Building

3.10.3.1. In cases where Work is scheduled to take place in or adjacent to occupied existing buildings, Contractor shall coordinate the Work as reasonably directed by the College's Project Manager to reduce impact of construction operations on building occupants.

3.10.3.2. Noise that disrupts classes cannot generally be tolerated. The Contractor shall notify the College's Project Manager before starting any work which might disrupt classes. Notification shall be given well in advance of any such situation in order that the Contractor and College's Project Manager together can reach a mutually agreeable time in which the work can be accomplished. Noise of a brief/infrequent nature may not be found necessary to reschedule. Always contact the College's Project Manager if in doubt. Any rescheduling required due to noise aversion will not be a cause for either a delay or cost claim.

3.10.3.3. When requested, Contractor shall provide a detailed adjacent work coordination plan indicating information including schedule of activities, limits of disturbance, sequence of construction, access points and their management, barriers, interface with controls such as fire alarm, security or building automation systems operation, for areas that directly interface with or are affected by the Work.

3.10.4. Temporary Facilities

Unless otherwise indicated in the Contract Documents:

3.10.4.1. The Contractor shall be responsible for arranging with the College's Project Manager for general services and temporary facilities as required for the proper and expeditious prosecution of the Work; including but not limited to: use of toilets; temporary storage; temporary electrical power; and temporary water.

3.10.4.2. The Contractor shall, at its own expense, make all temporary connections to utilities and services in locations acceptable to the College's Project Manager and local authorities having jurisdiction thereof; furnish all necessary labor and materials, and make all installations in a manner subject to the acceptance of such authorities and the College's Project Manager; separately meter and pay for utilities (electricity, water, sewer, and telephone) consumed; maintain such connections; remove the temporary installation and connections when no longer required; restore the services and sources of supply to proper operating conditions.

3.10.4.3. The Contractor shall supply and maintain an office trailer or shed and a telephone, telefax, and/or computer on the site for the purpose of facilitating construction coordination and communication.

3.10.4.4. At the completion of the Work, Contractor's onsite facilities shall be removed, and the site restored to conditions that meet or exceed those existing at the start of Work.

3.10.5. Existing Utilities

3.10.5.1. The attention of the Contractor is directed to the likely presence of existing underground utilities and overhead utilities and poles located within the work site. The Contractor is cautioned that some utilities may not be catalogued on College or utility service provider record documents. Further, due to depth and/or types of materials used, some utilities may not be identifiable using traditional utility service locating methods.

3.10.5.2. Where any underground services are expected to be encountered during construction, prior to the start of work, the Contractor shall:

- (1) Review College record documents pertaining to affected underground services.
- (2) Interview Campus Facilities office with regard to affected underground services.
- (3) Call "Miss Utility" at least 48 hours in advance of construction for marking of public utilities.
- (4) Be responsible for costs and coordination of utility locator services necessary to locate and mark any private utility services within the work site, whether or not indicated on record or contract documents.
- (5) Notify the College's Project Manager, Campus Facilities office, electric utility company, natural gas supplier, providers of communications, and any affected utility or other organization with a right-of way in or immediately adjacent to the work area at least one week prior to starting work in the areas in which services are located and cooperate with any organization who elects to have a representative present during the conduct of the work.

3.10.5.3. The Contractor shall exercise special care not to damage or disturb the utility infrastructure in any way.

3.10.5.4. The Contractor shall carefully hand dig representative test pits across the full width of anticipated trenches to confirm utility locations and to reveal any unknown utility conditions for assessment prior to permitting use of mechanical excavation equipment.

3.10.5.5. All underground utility locations associated with the scope of work, or revealed during the conduct of the work, including the location, size and material of all water, sanitary sewer, storm sewer, gas, electric, telephone, data, fiber, cable television, duct banks, steam and chilled water utilities within the project area, shall be recorded by the Contractor's surveyor and referenced to a campus benchmark provided by the College, which is in Maryland State Plane NAD83(NSRS2007) horizontal datum; NAVD88 vertical datum.

Indicate rim and invert elevation of sanitary sewers, storm sewers and storm water management structures. For all sub-surface utility lines on the site, locate the first connection to the off-site system. The horizontal and vertical location of all subsurface utilities must be measured directly prior

to backfill. Locations shall be recorded on project progress documents. Electronic record documentation, in Autocad format, is required at project close-out.

3.10.5.6. Contractor shall maintain utility paint marks and flags, showing utility location and depth, until work is complete and survey information is transferred to project progress documents.

3.10.5.7. Contractor shall notify the College's Project Manager and Campus Facilities Office when underground utilities are discovered that are not identified by prevailing industry standard marking methods (e.g. color-coded tape and trace wires for non-metallic utilities). Campus Facilities Office will coordinate proper marking of utilities prior to Contractor's completion of the work.

3.10.5.8. In the event that utility service is damaged during the conduct of the work, Contractor shall notify the College's Project Manager and Campus Facilities and Security Offices. Repair of damages resulting from Contractor's actions shall be the responsibility of the Contractor. Regardless of responsibility, Contractor shall immediately undertake necessary repairs, including conducting work off-hours and/or on weekends, to ensure prompt restoration of service in order to minimize impact of unplanned utility outages on College operations.

3.10.6. Erosion Control

3.10.6.1. The Contractor shall incorporate all permanent erosion control features, where applicable, into the Work at the earliest practicable time and shall maintain them in proper condition during the course of the Contract.

3.10.6.2. Temporary measures shall be used to control conditions that develop prior to installation of permanent control features, or that are needed to temporarily control erosion resulting from normal construction practices. Temporary controls may include off site control measures where such Work is necessary as a direct result of Contractor's construction activity.

3.10.7. Tree and Plant Protection

3.10.7.1. Unless otherwise shown in the Contract Documents, the Contractor shall protect all trees and plants which are liable to injury by construction operations and/or site mobilization plan.

3.10.7.2. Trees may not be used for any attachment or anchorage. Tree root zones shall be protected from overburden from construction traffic or storage of materials.

3.10.8. Snow and Ice Removal

3.10.8.1. Contractor shall provide snow and ice removal from within the project site area and from pedestrian or vehicular routes providing immediate access to or routing around the project site.

3.10.8.2. When the College is officially closed due to snow and ice conditions and the Contractor plans to work, it is the Contractor's responsibility to provide additional snow and ice removal, including removal beyond the site project limits, as necessary to provide access required by its Workers, Subcontractors and/or suppliers.

3.10.8.3. At all times, Contractor shall cooperate and coordinate his snow and ice removal activities with College's snow and ice removal activities.

3.10.9. Trash Removal: Salvage and Recycling

Unless otherwise indicated in the Contract Documents:

3.10.9.1. Salvage rights belong to the Contractor when the project scope of work includes demolition and removal of existing materials or equipment.

3.10.9.2. Contractor shall implement best recycling practices as part of its trash removal protocol, with particular attention to sorting and recycling corrugated cardboard packaging materials, wood pallets, paper products and metal products.

3.10.10. Project Signage

3.10.10.1. Contractor may place his identification signage for promotional purposes at the Project site, subject to review and approval by the College's Project Manager.

3.11 HAZARDOUS AND TOXIC SUBSTANCES

3.11.1. Hazardous and Toxic Substances

3.11.1.1. The Contractor shall comply with all applicable federal, state, bi-county and local laws, ordinances and regulations relating to hazardous and toxic substances, including such laws, ordinances and regulations pertaining to access to information about hazardous and toxic substances, in effect on the date of the Contract and as amended from time to time. The Contractor shall further comply with any special provisions or requirements, including more stringent provisions, mandated by any entity having jurisdiction, including but not limited to the Montgomery County Department of Environmental Protection.

3.11.1.2. At least ten (10) calendar days prior to commencing any on-site Work required by these Contract Documents, the Contractor shall compile, maintain and submit to the College's Project Manager a "Chemical Information List" which shall contain the following information for each hazardous and toxic substance used, manufactured, processed, formulated, packaged, repackaged, handled, reacted, transferred, or stored at the job site: the common name, the chemical name, and identification of the Work area in which the hazardous chemical is found. A copy of this list shall be posted at all times at the Contractor's on-site project office. This list shall be updated and maintained in a current status by the Contractor as to the hazardous and toxic substance used, manufactured, processed, formulated, packaged, repackaged, handled, reacted, transferred or stored at the job site. The Contractor shall submit to the College's Project Manager an updated Chemical Information List at least 48-hours prior to the introduction of any additional hazardous and toxic substance not listed on the current Chemical Information List which is to be used, manufactured, processed, formulated, packaged, repackaged, handled, reacted, transferred or stored at the job site.

3.11.1.3. The Contractor shall provide the College's Project Manager at least 48-hours prior to commencing Work requiring the use of a hazardous and toxic substance with a "Material Safety Data Sheet" or, in the case of a controlled hazardous waste substance, a hazardous waste manifest, for each hazardous and toxic substance listed or subsequently added to the Chemical Information List in compliance with applicable laws, ordinances and regulations.

3.11.2. Asbestos-Containing Materials

3.11.2.1. The Contractor shall not use, install, or apply any asbestos-containing building materials on any Work. Any exception to this requirement must be requested in writing by the Contractor with an explanation of Work requirements. The College will review any such request and must approve in writing the use of any asbestos-containing building materials on any Work prior to use, installation or application. Upon completion of the project and before final acceptance is issued by the College,

the Contractor shall provide the College's Project Manager with written and notarized certification that it did not use, install or apply asbestos-containing materials.

3.11.3. Environmental Litigation

3.11.3.1. If the performance of all or any part of the Work is suspended, delayed or interrupted due to an order of a court of competent jurisdiction as a result of environmental litigation as defined below, or by the order of any state or federal agency or official enforcing applicable laws, such expense, delay or interruption shall be considered as if ordered by the College under Article 2, College's Right To Stop Or Suspend Work. If it is determined that the suspension, delay, or interruption is due wholly or in part to acts or omissions of the Contractor or breach or violation of the terms of this Contract or acts of the Contractor not required by this Contract, the Contractor shall be responsible for all additional costs and delays resulting from such acts or omissions. The term "environmental litigation" as used herein means a complaint filed in court alleging that the Work will have an adverse effect on the environment and that the College has not duly considered, either substantively or procedurally, the effect of the Work on the environment.

3.12. CUTTING AND PATCHING

3.12.1. The Contractor shall be responsible for any cutting, fitting, or patching, required to complete the Work or to make its parts fit together properly.

3.12.2. The Contractor shall not damage or endanger a portion of the Work or other construction of the College or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the College or a separate contractor except with written consent of the College and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the College or a separate contractor the Contractor's consent to cutting or otherwise altering its Work.

3.13. CLEANING

3.13.1. Progress Cleaning

3.13.1.1. The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract, and shall remove and dispose of waste materials or rubbish prior to the end of each working day.

3.13.1.2. If the Contractor fails to clean up as provided in the Contract Documents, the College's Project Manager may do so and the cost thereof shall be charged to the Contractor.

3.13.2. Final Cleaning

3.13.2.1. At completion of the Work the Contractor shall remove from and about the Work waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials.

3.13.2.2. Contractor shall wet clean all floors and surfaces or otherwise clean any equipment and materials installed in accordance with manufacturer's instructions.

3.14. ROYALTIES, PATENTS AND LICENSE FEES

3.14.1. The Contractor assumes the risk that any materials, equipment, processes or other items required under the Contract or furnished by the Contractor are subject to any patent, copyright, mark, secret or other property right of another. The Contractor shall pay for all royalties and license fees and shall obtain all necessary licenses or permits to permit use of any such item by the College. Contractor shall defend all suits or claims of infringement of any patent, copyright, mark, secret or other property right of another and shall save the College harmless from loss or expense on account thereof.

3.14.2. When an item specified by the College or furnished by the Contractor infringes or is alleged to infringe any patent, copyright, mark, secret or other property right of another, the Contractor will, at its option, and at no additional cost to the College, (1) procure for the College the right to use the item; (2) replace the item with an approved, non-infringing equal; or (3) modify the item so that it becomes non-infringing and performs substantially the same as the original item.

3.14.3. The review by the College of any method of construction, invention, appliance, process, article, device or material of any kind shall be for its adequacy for the Work, and shall not be an approval of the use thereof by the Contractor in violation of any patent or other rights or any third person.

3.15. INDEMNIFICATION

3.15.1 The Contractor shall be responsible for any property damage, loss, personal injury, death and/or any other damage which may occur by reason of the Contractor's acts, negligence, willfulness or failure to perform any of the obligations required by this Agreement. The Contractor agrees to indemnify and save harmless the College and its respective employees, volunteers, students, and trustees, as applicable, (the "Indemnitees") from any claims, loss, costs, damages or other expenses suffered or incurred by the Indemnitees, including attorneys fees and costs, by reason of the Contractor's acts, negligence, willfulness or failure to perform any of the obligations required by this Agreement. The Contractor at its own expense shall defend the Indemnitees in any action or suit brought against any of the Indemnitees arising out of the Contractor's acts, negligence, willfulness or failure to perform any of the obligations required by this Agreement. Any acts, negligence, willfulness or failure to perform any of the obligations required by this Agreement on the part of any agent, servant, employee or Subcontractor of the Contractor, or any Subcontractor's agent, servant or employee, are deemed to be the Contractor's acts, negligence, willfulness or failure to perform any of the obligations defined by this Agreement.

3.15.2 In claims against any person or entity indemnified under subsection 3.15.1 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under subsection 3.15.1 shall not be limited by a limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers or workmen's compensation acts, disability benefit acts or other employee benefit acts.

3.15.3. The College may retain such moneys due or to become due the Contractor under this Agreement as it considers necessary until such suits or claims for damages have been settled or otherwise disposed of and satisfactory evidence to that effect has been furnished to the College.

3.15.4. The provisions of this Article shall survive the termination of the Agreement.

ARTICLE 4 – ADMINISTRATION OF THE CONTRACT**4.1. CLARIFYING INSTRUCTIONS**

4.1.1. The College shall be the final interpreter of the Contract Documents. Through the College's Project Manager, the College will furnish, with reasonable promptness, such clarifications as it may deem necessary for the proper execution of the Work. Except as otherwise expressly provided in the Contract Documents, all recommendations by the Architect/Engineer and/or College's Project Manager with cost or schedule ramifications are subject to approval by the College. The Work shall be executed in conformity therewith and the Contractor shall do no work without proper drawings and instructions. The Architect/Engineer and/or College's Project Manager have no authority to waive or change the requirements of the Contract Documents except to make minor changes in the Work which do not result in a claim for extra cost or time, and which are consistent with the intent of the Contract Documents.

4.1.2. Wherever typical parts or sections of the Work are completely detailed on the drawings and other parts or sections which are essentially of the same construction are shown in outline only, the complete details shall apply to the Work which is shown in outline.

4.1.3. Dimensions of work shall not be determined by scale or rule. Figured dimensions shall be followed at all times. If figured dimensions are lacking on drawings, the Architect/Engineer shall supply them on request to the Contractor.

4.2. REQUESTS FOR INFORMATION

4.2.1. In the event that the Contractor requires clarifications on or discovers conflicts or discrepancies in the Contract Documents, the Contractor shall submit a "Request for Information", in a format suitable to the College's Project Manager and Architect/Engineer prior to proceeding with the work.

4.2.2. Unless otherwise indicated in the Contract Documents, the Contractor shall prepare and routinely update an RFI log indicating the status of RFIs.

4.2.3. The Contractor must allow the Architect/Engineer, College's Project Manager and the College a reasonable time following receipt of each RFI to review the documents and respond to the Contractor. To the extent that additional time for review is needed to clarify the information submitted by the Contractor or its Subcontractors and suppliers, the Contractor will be notified of the cause of the delay and advised of how long it will take to complete the review; provided, however, that mere failure to give the Contractor such notice shall not entitle the Contractor to make a claim for additional compensation or a time extension. The Architect/Engineer will return the completed RFI response to the Contractor and also provide one copy each to the College and College's Project Manager.

4.2.4. The Contractor shall perform no portion of the Work requiring RFI response until the respective RFI response has been issued by the Architect/Engineer. Work performed without a response shall be at the Contractor's risk.

4.2.5. Should the Contractor consider any RFI response to cause a change in the scope of the Work from that required by the Contract Documents, whether or not such change may affect contract price or time, then the Contractor shall desist from further action relative to the item in question and shall in writing (1) immediately notify the Architect/Engineer, the College and College's Project Manager requesting clarification; and (2) furnish them, within seven (7) days, with a notice explaining the nature of the change and whether increased or decreased cost and/or time is anticipated. No Work shall be executed until the entire matter is clarified and the Contractor is ordered by the College to proceed. Failure of the Contractor to serve written notice as required herein shall constitute a waiver of any claim in relation thereto.

4.3. SITE VISITS AND OBSERVATIONS

4.3.1. The College's Project Manager, and Architect/Engineer, shall at all times have access to the Work wherever it is in progress. The Contractor shall provide proper and safe facilities for such access and for visits at the place of manufacture or elsewhere.

4.3.2. Inspections by the College's Project Manager, or Architect/Engineer, are for the sole benefit of the College. If the Specifications, the College's, College's Project Manager's, and Architect/Engineer's instructions, laws, ordinances or any public authority require any Work to be specially tested or reviewed, the Contractor shall give the College's Project Manager timely notice of the Work's readiness for inspection. If the Work is scheduled to be inspected by an authority other than the College's Project Manager, and Architect/Engineer, the Contractor shall inform the College's Project Manager of the date fixed for such inspection. Required certificates of inspection shall be secured by the Contractor. Inspections by the College's Project Manager and Architect/Engineer shall be made promptly and where practicable, inspections may be made at the source of supply.

4.3.3. If any Work has been covered up contrary to the requirements of the Contract Documents or instructions of the College's Project Manager or Architect/Engineer before it has been observed, such Work must, if required by the College's Project Manager and/or Architect/Engineer, be uncovered for observation and replaced and/or recovered, at the Contractor's expense.

4.3.4. If any questioned Work has been covered up which is not required to be observed by the College's Project Manager and/or Architect/Engineer prior to being covered, the College's Project Manager and/or Architect/Engineer may request to see the Work in question and it shall be uncovered by the Contractor as directed. If such Work is found to be in accordance with the requirements of the Contract Documents, the College shall reimburse the Contractor for the cost of such uncovering and recovering. Such reimbursement shall be limited to the direct cost incurred plus the contract's approved percentage for overhead and profit. If the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall pay all costs associated with uncovering, correcting and recovering the Work.

4.3.5. The Contractor shall place its field engineers at the College's Project Manager's or Architect/Engineer's disposal for field checking during any inspection period. When layouts of the building and site work are to be made, the Contractor shall notify the College's Project Manager and Architect/Engineer in sufficient time so that the College's Project Manager and Architect/Engineer may be present.

4.3.6. Neither the presence nor the absence of the College's Project Manager or Architect/Engineer on the job shall relieve the Contractor from responsibility to comply with the provisions of the Contract Documents, nor from responsibility to remove and replace Work not in accordance therewith.

4.4. CLAIMS AND DISPUTES

4.4.1. Definition of Claim

4.4.1.1. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time, or other relief with respect to the terms of the Contract. The term "claim" also includes other disputes and matters in question between the College and Contractor arising out of or relating to the Contract. Claims must be made by written notice. The responsibility to substantiate claims shall rest with the party making the claim.

4.4.2. Claims for Concealed or Unknown Conditions

4.4.2.1. If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then the Contractor shall give notice to the College's Project Manager promptly before conditions are disturbed and in no event later than fifteen (15) calendar days after first observance of the conditions. Upon receipt of such notice the College's Project Manager and Architect/Engineer will promptly investigate such conditions and if they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work will determine an equitable adjustment in the Contract Sum or Contract time or both. No change in the Contract Sum or Contract time or both will be allowed except by formal approval of the College. If it is determined that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the College's Project Manager shall so notify the Contractor in writing stating the reasons. Claims by Contractor which dispute such a determination must be made in accordance with subsection 4.4.5.

4.4.3. Claims for Extension of Time

4.4.3.1. If the Contractor is delayed at any time in the progress of the Work by any act or omission of the College, or its employees or by any other contractor employed by the College, or by changes ordered in the Work, or by strikes, lockouts, fire, unavoidable casualties, or any causes beyond the Contractor's control, or by delay authorized by the College pending a decision, or by any cause which the College shall decide to justify the delay, the time of completion shall be extended for such reasonable time as the College may decide.

4.4.3.2. The Contractor may be entitled to a time extension, but no additional compensation, if the delay in the completion of the Work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God, acts of the public enemy, acts of another contractor in the performance of a contract with the College, fires, floods, epidemics, quarantine restrictions, strikes, foreign embargoes, unusually severe weather, or delays of Subcontractors or suppliers arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the Subcontractor or suppliers, the time of completion shall be extended for such reasonable time as the College may decide.

4.4.3.3. Claims for extension of time will be considered by the College only if made in writing to the College. Any claim for an extension of time must be made within seven (7) calendar days of the occurrence of conditions which in the opinion of the Contractor warrant such an extension. In the case of a continuing cause of delay, only one claim is necessary. Within thirty (30) days of filing a time extension claim notice, the Contractor shall submit a clear written statement and relevant supporting documentation substantiating the claim. The documentation shall include a revised schedule, which conforms to the schedules submitted each month with the payment requests and which shows the duration of the delay, its relation to other activities, and how the alleged delay was on the critical path. No time extension will be allowed except by formal approval of the College. The College with advice and assistance from the College's Project Manager shall ascertain the facts and the extent of the delay and extend the time for completing the Work, when in the College's judgment the findings of fact justify such an extension. The College's findings of fact shall be final and conclusive on the parties, subject only to appeal as provided in section 4.5 of this Contract.

4.4.4. Claims for Equitable Adjustment for Delay

4.4.4.1 If a Delay in completion of the Work is authorized in writing by the College and compensation is not provided for under Changes in the Work otherwise negotiated, and the Contractor's work is materially affected by that Delay, then the Contractor may be entitled to submit a claim for an equitable adjustment in compensation.

4.4.4.2 Schedule management within the contract duration established at time of Bid/Proposal, including decisions that may alter sequencing of all or part the work, does not constitute grounds for an Equitable Adjustment for Delay claim from Contractor or his subcontractors or vendors. All prices are firm for the duration of the overall contract term.

4.4.4.3 Only the following items may be recoverable by the Contractor as compensation or damages for delay:

- (1) direct costs, consisting of
 1. actual additional salaried and non-salaried on-site labor expenses;
 2. actual additional costs of materials;
 3. actual additional equipment costs, based solely on actual ownership costs of owned equipment or actual reasonable costs of rented or leased equipment;
 4. actual additional extended field office expenses, excluding those which are to be included in overhead;
 5. actual additional reasonable costs of subcontractor and suppliers at any tier for which the Contractor is liable;
- (2) actual additional costs proven by clear and convincing evidence, resulting from labor or other inefficiencies proven by clear and convincing evidence; and
- (3) an additional percentage for overhead and profit of 15% for actual additional Work performed by the Contractor's own forces and 5% for actual additional Work performed by a Subcontractor.

4.4.4.4. No claim under this subsection shall be allowed for any costs incurred more than twenty days before the Contractor shall have notified the College in writing of the Delay.

4.4.4.5. No other compensation or damages are recoverable by Contractor for compensable delays or extensions of the completion time except as expressly stated herein. In particular, the College will not be liable for the following (by way of example and not of limitation) whether claimed by the Contractor or by a Subcontractor or supplier at any tier: (a) profit in excess of that provided herein; (b) loss of profit; (c) home office or other overhead in excess of that provided herein; (d) overhead calculated by use of the Eichleay formula or similar formulae; (e) consequential damages of any kind, including loss of additional bonding capacity, loss of bidding opportunities, and insolvency; (f) indirect costs or expenses of any nature except those expressly provided for herein; and (g) attorneys fees, costs of claims preparation and presentation, and costs of litigation.

4.4.4.6. There shall be deducted from the compensation payable to the Contractor under this section for delay any and all costs, expenses, and overhead recovered or recoverable by the Contractor under change orders issued to the Contractor or otherwise recovered or recoverable by the Contractor.

4.4.4.7. Contractor shall not be entitled to compensation or damages for delay unless, within seven (7) calendar days of the act, omission, occurrence, event or other factor alleged to have caused the delay, the Contractor notifies the College in writing of (a) the alleged delay and its anticipated duration; and (b) the act, omission, occurrence, event or other factor allegedly causing the delay. Knowledge on the part of the College or College's Project Manager of the act, omission, occurrence, event, or other factor or of the delay allegedly resulting there from, shall not excuse Contractor's failure to give the College the written notice required by this subsection.

4.4.5. Claims and Disputes Procedure

4.4.5.1. Unless a lesser period is prescribed by the Contract, the Contractor shall file a written notice of claim relating to the Contract, to the College's Project Manager within fifteen days after the basis of the claim is known or should have been known, whichever is earlier. Contemporaneously with, or within thirty days of filing of a notice of claim, but no later than the date that final payment is made, the Contractor shall submit the claim to the College's Project Manager. The claim shall be in writing and shall contain:

- (1) an explanation of the claim, including references to all Contract provisions upon which it is based;
- (2) the amount of the claim;
- (3) the facts upon which the claim is based; and
- (4) all pertinent data and correspondence that the Contractor relies upon to substantiate its claim. The Contractor shall submit such additional information as may be requested by the College's Project Manager.

4.4.5.2. A notice of claim or a claim that is not filed within the time prescribed by subsection 4.4.5.1 or a lesser period prescribed elsewhere in the Contract shall be dismissed and the claim shall be considered to be waived.

4.4.5.3. Upon receipt of the Contractor's claim, the College's Project Manager, shall take steps deemed necessary to review and investigate the claim. These steps may include an investigation and review of the facts pertinent to the claim, requesting additional information or substantiation from the Contractor or anyone else and taking such other steps as the College's Project Manager may consider appropriate.

4.4.5.4. Following their investigation, the College's Project Manager shall issue a written opinion regarding the claim, which shall contain such information as they consider appropriate.

4.4.5.5. Pending resolution of a claim, the Contractor shall proceed diligently with the performance of the Contract in accordance with the College's Project Manager's opinion, order, finding or interpretation. The Contractor shall take all reasonable action to mitigate or to avoid costs or damages for which the College may be liable. The College Project Manager's decision shall be final and conclusive unless the Contractor files a written appeal to the Vice President of Facilities & Security within fifteen days of the date of the College's Project Manager's opinion. The Contractor shall include in its appeal all of the information which it wants considered in the appeal. The Vice President of Facilities & Security, in consultation with such other persons as deemed advisable, shall prepare and deliver a written decision to the Contractor. The Associate Vice Presidents' response shall be the College's final decision.

4.4.5.6. If the Contractor does not appeal the College's Project Manager's decision to the Vice President of Facilities & Security within the time required under subsection 4.4.5.5, then the College's Project Manager's opinion shall be considered to be final, conclusive and binding upon the Contractor and College. There shall be no further right of review either administratively or in the courts. If the Contractor's timely appeals the College's Project Manager's decision to the Vice President of Facilities & Security, the Vice President of Facilities & Security' decision shall be considered to be conclusive and final unless within thirty days from the date of the Vice President of Facilities & Security' decision the Contractor requests submitting the dispute to non-binding mediation as a precedent to commencing an action in the Circuit Court for Montgomery County. If no action is commenced within thirty days after the date of the Vice President of Facilities & Security' decision, the Vice President of Facilities & Security' decision shall be considered to be final, conclusive and binding on the Contractor and the College and the Contractor's right to appeal to the courts shall be waived.

4.4.5.7. If a court action is contemplated, all claims, disputes and other matters in question arising out of or related to the Contract or breach thereof shall first be submitted to non-binding mediation. Such mediation shall be in the nature of settlement discussions and privileged. The location of the mediation shall be in Rockville, Maryland.

4.4.5.8. The timely filing of a claim and the receipt of an opinion by the Contractor from the College's Project Manager, receipt of a decision from the College's Vice President of Facilities & Security and pursuit of non-binding mediation are conditions precedent to filing an action in court. Any action which may be commenced against the College shall be filed in the appropriate state court in Montgomery County, Maryland. The Contract and disputes arising out of it shall be governed by the

laws of the State of Maryland without regard to conflicts of laws provisions.

4.4.5.9. Claims by the College against the Contractor may be commenced at any time in any appropriate court without regard to the other provisions of the Contract Documents, including subsection 4.4. This right is in addition to all other rights which the College may have under the Contract Documents.

4.5. DELAYS AND DAMAGES

4.5.1. Delays beyond the control of the Contractor

4.5.1.1. In the event the performance of work or services under this Agreement is delayed by causes beyond the control of and without the fault or negligence of the Contractor, the College shall have the option to:

- (1) Terminate the Agreement, or
- (2) Allow the President of the College or their designee to extend the time for performance. No monetary compensation will be awarded for the time extension.

4.5.1.2. Any changes made in this Agreement as a result of delay shall be in writing. In the event the time for performance of this Agreement is extended beyond the term provided for, all other terms and conditions shall remain in full force and effect.

4.5.2. No Waiver of Delay

4.5.2.1. Except as may be expressly agreed otherwise by the College in writing, no action or inaction by the College or its Project Managers shall constitute a grant of an extension of the completion date or the waiver of a delay or other default by the Contractor, including: (1) schedule, a recovery schedule, or an anticipated completion date from Contractor; (2) allowance, approval or acceptance of any schedule; (3) failure to terminate for default at an earlier date; or (4) demand that the Contractor finish the project by the required completion date or by any subsequent date promised by the Contractor.

4.5.3. Mitigation of Delays and College Remedies.

4.5.3.1. If Contractor should at any time cause interference, stoppage or delay to the Project or any activity necessary to complete the Project by the time required by this Contract (collectively, "Delay"), Contractor shall take all reasonable action to avoid or mitigate the effects the Delays, including but not limited to: (1) rescheduling or re-sequencing the Work and (2) re-assigning personnel. When the Contractor is responsible for any Delay, the College may order the Contractor to accelerate construction, work overtime, add additional shifts or manpower, work on weekends, or to do anything else reasonably necessary in order to finish on time, at no additional cost to the College. The Contractor does not have the unilateral right to complete the Work late and pay liquidated or other damages.

4.5.3.2. If Contractor should at any time cause the Delays described in subparagraph 4.5.3.1, then in addition to any other remedies the College may have under the Contract, the College, after notifying Contractor that it has forty-eight (48) hours within which to cure the Delay, may attempt to remedy the Delay by whatever means the College may deem necessary or appropriate including, but not limited to, correcting, furnishing, performing or otherwise completing the Work, or any part thereof by itself or through others, (utilizing where appropriate, any materials and equipment previously purchased for that purpose by Contractor), or by supplementing the Contractor's forces. The Contractor shall be liable to the College for all costs incurred by the College in attempting to remedy the Delay. The College may deduct the cost to remedy the Delay from any monies due or to become due to the Contractor.

4.5.4. Waiver of Right to a Time Extension

4.5.4.1. Failure of the Contractor to request a time extension within seven (7) calendar days of the time the Contractor should have known about the delay to which it might otherwise be entitled, shall constitute a waiver of the Contractor's right to an extension of the required completion date, except that subsection 4.5.5 shall be separately applied if necessary.

4.5.5. Severe Weather Delays

4.5.5.1. "Unusually severe weather" is weather which is more severe than the historical average for the month as evidenced by the National Weather Service for the locality of the Work. Time extensions for unusually severe weather will be allowed on a tentative basis only and the final decision will be reserved until the Work is substantially completed. Weather conditions prevailing throughout the entire Contract period will be considered, including consideration for abnormally mild conditions to offset abnormally severe conditions. Extension of time due to abnormal weather conditions will be granted on the basis of one (1) calendar day for each normal working day lost, or as mutually agreed upon by the College and the Contractor. No additional compensation will be provided to the Contractor.

4.5.6. Liquidated Damages

4.5.6.1. It is agreed that time is of the essence and therefore the College will suffer substantial damages if the Work is not completed within the time stated in the Preliminary Project Schedule contained in the Contract Documents. For each day that the Work shall be uncompleted after the contract completion date, the Contractor may be liable for liquidated damages in the amount specified in the Contract Documents. Prior to and after expiration of the Contract completion time, the College may withhold an amount equal to liquidated damages whenever the progress of construction is such that, due to the fault or responsibility of the Contractor, the Contractor, in the judgment of the College is behind schedule so as not reasonably to be able to permit completion of the Project on time. Due account shall be taken of excusable delays, any extensions of time reasonably due the Contractor for completion of additional Work under change orders, and for delays for which the College is responsible, provided that the Contractor has properly requested time extensions therefore. After submission of a price, the Contractor may not contest the reasonableness of the amount of liquidated damages stated in the Contract. These assessed damages shall not be considered as a penalty, but as mutually agreed upon as the ascertained damages suffered by the College because of the delay.

ARTICLE 5 – CONSTRUCTION BY COLLEGE OR BY SEPARATE CONTRACTORS**5.1 SEPARATE CONTRACTS**

5.1.1. The College reserves the right to let other contracts in connection with the Project. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and for the execution of their work, and shall properly connect and coordinate its Work with theirs. The Contractor shall work harmoniously with other contractors. The Contractor is not entitled to overhead, profit, or other compensation for work done for the College by other contractors.

5.1.2. If any part of the Contractor's Work depends on the proper execution or completion of any other contractor's work, the Contractor shall inspect and measure the work of the other contractor(s) and promptly report to the College's Project Manager any defects or discrepancies in such work. The Contractor's failure to inspect and make such a report shall constitute an acceptance of the other contractor's work as fit and proper for the proper execution of its Work, except as to latent defects.

5.1.3. The College's Project Manager will schedule and coordinate the Work of the Contractor with the work of all separate contractors on the Project including use of the site by the Contractor and the separate contractors. The College's Project Manager will keep the Contractor informed of the progress schedule to enable the Contractor to reasonably plan and perform its Work properly. The College's Project Manager may issue appropriate directions and require the Contractor to take such other measures as may be necessary to timely coordinate and progress the Work. Any neglect or refusal by the Contractor to comply with directions issued by the College's Project Manager shall constitute a failure to perform the Work in accordance with the Contract requirements and will justify action from withholding of payments otherwise due up to and including termination of the Contract.

5.1.4. The College and College's Project Manager do not guarantee the unimpeded operations of the Contractor. The Contractor acknowledges that the award of more than one contract for a Project necessitates the proper scheduling and sequencing of the Work with the work of all other contractors, and may lead to inherent delays in the progress of the Work. The Contractor agrees to re-sequence his work as may be reasonably directed by the College's Project Manager from time to time. The Contractor hereby agrees to make no claim for delays caused by the presence or operations of other contractors engaged on the Project.

5.1.5. Should the Contractor sustain any damage through any act or omission of any other contractor having a contract with the College for the performance of work on the Project, or through any act or omission of a subcontractor of such other contractor, the Contractor shall make no claim against the College or its consultants (including but not limited to the Architect/Engineer and College's Project Manager) for such damage, but shall have a right to recover such damage from the other contractor under a provision similar to subparagraph 5.1.6 which has been or will be inserted in all contracts with such other contractors. The Contractor hereby releases the College, College's Project Manager and Architect/Engineer and their respective officers and employees from all damages to the Contractor caused by other contractors on the Project.

5.1.6. Should any other contractor under contract with the College for performance of work on the Project sustain any damage through any act or omission of the Contractor hereunder, or through any act or omission of a Contractor's subcontractor of any tier, the Contractor agrees to reimburse such other contractor for all such damages and to indemnify and hold the College, College's Project Manager and Architect/Engineer harmless from all such claims, including attorneys' fees, to the fullest extent permitted by law.

5.1.7. The Contractor agrees that in the event of a dispute as to cooperation or coordination with other contractors on the Project, the College's Project Manager will act as mediator and decisions made by the College's Project Manager will be binding.

5.1.8. The Contractor shall fully cooperate and coordinate its Work with other contractors working on separate projects for other buildings, road work, and the like in accordance with College's Project Manager's direction.

5.1.9. Wherever work being done by any contractors or subcontractors is contiguous to Work covered by the Contract Documents, the respective rights of the parties shall be established by the College's Project Manager to secure the completion of the various portions of the Work in general harmony.

5.1.10. If a dispute arises among the Contractor and other contractors as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish as described in these General Conditions, the College's Project Manager may direct who shall perform the clean up. The College's Project Manager reserves the right to clean up and allocate the cost in a timely manner among those responsible as the College's Project Manager determines to be just.

ARTICLE 6 – CHANGES IN THE WORK**6.1. CHANGES IN THE WORK****6.1.1. Changes**

6.1.1.1. The College unilaterally may, at any time, without notice to the sureties, if any, and without invalidating the Contract Documents, by written order designated or indicated to be an order, make any change in the Work including but not limited to changes in the Specifications, Drawings in the method or manner of performance of the Work, the College-furnished facilities, equipment, materials, services, or site or directing acceleration in the performance of the Work. Any other written order or an oral order, including a direction, instruction, interpretation, or determination from the College that causes or constitutes any such change shall be treated as a change order under this clause provided that before performing the Work directed by the change that the Contractor gives the College's Project Manager written notice stating the date, circumstances and source of the order and that the Contractor regards the order as a change order. The Contractor shall not proceed to perform the Work described in the written or oral order unless the College's Project Manager acknowledges in writing to the Contractor that the order is a change order and that the Contractor is to proceed with the Work as a change.

6.1.1.2. If any change under this subsection causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the Work under the Contract, whether or not changed by an order, an equitable adjustment shall be made and the Contract modified in writing accordingly; provided, however, except for claims based on defective Specifications or Drawings, that no claim for any order under subsection 6.1.1.1 above shall be allowed for any cost incurred more than twenty days before the Contractor gives written notice as therein required; and provided further that in the case of defective Specifications or Drawings for which the College is responsible, the equitable adjustment shall include any increased costs reasonably incurred by the Contractor in attempting to comply with such defective Specifications or Drawings.

6.1.1.3. If the Contractor intends to assert a claim for an equitable adjustment under subsection 6.1.1, it shall, within thirty days after receipt of an order for the furnishing of written notice under subsection 6.1.1.1 submit to the College's Project Manager a written statement setting forth the general nature of the monetary extent of the claim.

6.1.2. Disputed Work

6.1.2.1. In the event of a dispute between the College and the Contractor as to whether any Work is included in the scope of the Contract, such that the Contractor will be obligated to provide that Work at no additional cost to the College, the College's Project Manager may order the Contractor in writing under this section to perform the Work. If the Contractor considers such an order to be a change in the scope of the Contract entitling the Contractor to additional compensation, a time extension, or other relief, the Contractor must provide notice within seven days (7) from receipt of the College's Project Manager's written order under the section to perform the Work and to initiate a claim therefore in accordance with Contract requirements.

6.1.2.2. A request by the Contractor for additional time or additional costs caused by the impact of an order of the College on the critical path for completion must be accompanied by (a) a reasonably detailed description of the effect of the order on the adjusted critical path and (b) supporting documentation. The mere existence of a change order does not entitle the Contractor to an extension of time, compensation for delay or damages or costs associated with delay. Contractor's entitlement thereto shall depend upon the effect of the change order on the adjusted critical path for completion and shall be subject to the requirements of Article 3.7, Prosecution and Progress of the Work.

6.1.2.3. Upon receipt of a signed written order of the College's Project Manager under this subsection, the Contractor shall comply with the order promptly, within the requirements of the completion schedule, whether or not the Contractor signs or accepts the change order. Failure to comply with the order in a timely manner shall constitute a breach of the Contract and grounds for termination for default or any other remedy available to the College.

6.1.3. Modification of Contract Sum

6.1.3.1. When changes in the Work may require a modification of the Contract Sum, the Contractor shall provide to the College's Project Manager, within thirty (30) days of its receipt of a proposal request, an itemized breakdown showing quantities, unit costs, hours and rates of labor, and other costs in such detail as may be required to allow the reasonableness of the cost to be established. Similar cost information covering Subcontractor's Work shall be included as part of the Contractor's proposal. Minimum charges for "handling" will not be acceptable. Charges for general supervision and management will not be acceptable.

6.1.3.2. Modification of the Contract Sum, when required, shall be determined as follows:

- (1) When applicable unit prices are stated in the Contract or have been subsequently agreed upon, by application of such unit prices.
- (2) A lump sum price agreed upon by the College and the Contractor.
- (3) If job conditions or circumstances or the extent or nature of the change, or failure of the College and the Contractor to agree upon a lump sum price or the application of unit prices, prevent the determination of the cost of any proposed change, the Work shall be paid pursuant to subsection 6.1.3.4.
- (4) If a change involves a credit to the College, unless the amount must be determined by the application of unit prices, the amount of the credit shall be the greater of (a) the alternate or other itemized price for such Work stated in Contractor's price or (b) a reasonable price, including profit and overhead.
- (5) If the change involves both a credit and a debit, the sums shall be shown and the two sums balanced to determine the adjusted total cost or credit.
- (6) The mark up allowable to the Contractor for combined overhead and profit for Work performed solely by the Contractor with its own forces shall be a reasonable amount, but not to exceed 15% of the Contractor's costs (excluding items includable in overhead).
- (7) The mark up allowable to a Subcontractor for combined overhead and profit for Work performed solely with its own forces shall be a reasonable amount, but not to exceed 15% of the Subcontractor's cost of labor and materials and equipment. Mark ups for Sub-subcontractors or suppliers, if required, must be provided from within the markup allowance provided to the Subcontractor. No additional mark up allowance will be allowed for Sub-subcontractors or suppliers. For Work performed by a Subcontractor solely with its own forces, the Contractor is entitled to a reasonable mark up for combined overhead and profit, but not to exceed 5% of the Subcontractor's labor, materials and equipment cost.

Sample Maximum Mark-Up Calculation:

A.	Subcontractor's cost (LME)	= A
	<i>(includes direct costs of Subsubcontractors and/or suppliers)</i>	
B.	Subcontractor's combined OH&P	= 15% of A
C.	Subcontractor's Bonds and Builder's Risk Insurance if required	= as a % of A+B
D.	Contractor's combined OH&P	= 5% of A+B+C
E.	Contractor's Bonds and Builder's Risk Insurance if required	= as a % of A+B+C+D
F.	Total Maximum Modification of Contract Sum:	= A+B+C+D+E

- (8) The Contractor shall be allowed the actual, reasonable additional cost for rental of machine power tools or special equipment, including fuel and lubricants which are necessary to execute the Work required on the change, but no percentage shall be added to this cost.
- (9) The Contractor and separately bonded subcontractors, if any, shall be allowed the actual, reasonable additional cost for Bonds and Builder's Risk Insurance, if required.

6.1.3.3. The allowable percentages for cost and overhead and profit as provided in subsections 6.1.3.2 (6) and (7) and elsewhere are deemed to include but not be limited to all costs and expenses of the following kinds: project management, supervision and coordination; job supervision and field office expenses required by the Contract; expenses for supervisors, superintendents, managers, timekeepers, clerks and watchmen; cost of correspondence of any kind; insurance not specifically mentioned herein; all expenses in connection with the maintenance and operation of the field office, use of small tools, cost of vehicles generally used for transporting either Workers, materials, tools or equipment to job location and incidental job burdens; and all expenses or maintenance for operation of Contractor's regularly established principle office, branch office, similar facilities and all other costs and expenses customarily classified as overhead. The Contractor's entitlement to compensation or additional time for delays for which the College is responsible or for which an extension is due to the Contractor is also subject to Article 4.5.

6.1.3.4. If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the method and the adjustment shall be determined by the College on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including in case of an increase in the Contract Sum, a reasonable allowance for overhead and profit as stated in subsection 6.1.3.2 (6) and (7). In such a case, the Contractor shall keep and present in such form as the College's Project Manager may prescribe an itemized accounting together with appropriate supporting data. The itemized accounting shall be prepared daily and presented to the College's Project Manager at the conclusion of each day. Unless otherwise provided in the Contract Documents, reimbursable costs to the Contractor shall be limited to the following:

- (1) Costs of labor, including Social Security, old age and unemployment insurance, fringe benefits required by agreement or custom and Workers' compensation insurance;
- (2) Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
- (3) Rental costs of machinery and equipment exclusive of hand tools, whether rented from the Contractor or others; and
- (4) Cost of premiums for all bonds and insurance and permit fees related to the Work, provided that, the penal sum of the surety bond has been increased and the surety has increased the premium cost to the Contractor.
- (5) Pending final determination of the costs accumulated pursuant to subsection 6.1.3.4, amounts not in dispute may be included in an Application for Payment.

6.1.3.5. The College's Project Manager will review and make a recommendation regarding the adjustment in Contract Sum and/or Time proposed by the Contractor to the College. Only the College is authorized to approve adjustments in Contract Sum and/or Time. Approval by the College requires review and administrative processing, based on claim value, in accordance with the Board of Trustees Policy and Procedures, and the following schedule:

- Claims less than \$ 99,999 require review and approval by the College's Vice President for Facilities & Security.
- Claims between \$ 100,000 and \$ 249,999 require review and approval by the College's Vice President for Administrative and Fiscal Services.
- Claims \$ 250,000 and greater require approval by the College's Board of Trustees as an action item at a monthly business meeting. Items requiring such approval must follow Board of Trustees agenda action item submission requirements. (Normally, action items are placed on the Board meeting agenda at least one month prior to the scheduled meeting date to allow time to conduct necessary internal administrative reviews prior to the Board meeting.)

6.1.4. Minor Changes in the Work

6.1.4.1. The College's Project Manager will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order of the College's Project Manager and shall be binding on the College and Contractor. The Contractor shall carry out such written orders promptly.

ARTICLE 7 – PAYMENTS AND COMPLETION

7.1. SCHEDULE OF VALUES

7.1.1. To facilitate checking the Work performed, the Contractor shall furnish to the College's Project Manager a detailed Schedule of Values of the various parts of the Work, including quantities, aggregating to the total sum of the Contract. The schedule shall be divided so as to facilitate payments to Subcontractors, if any, made out in the form prescribed by the College's Project Manager, and, if required, supported by such evidence of its correctness as the College's Project Manager may direct. The Schedule of Values cost breakdown shall be used as a basis for Certificates of Payment unless it is found to be in error.

7.1.2. The Schedule of Values shall be submitted as soon as possible, but not less than fifteen (15) days prior to the first scheduled Application for Payment described in the General Conditions.

7.2. PROGRESS PAYMENTS

7.2.1. Application for Payment

7.2.1.1. No later than the 25th day of each month, the Contractor shall submit to the College's Project Manager an original and accurate Application for Payment dated the last day of the month in the form prescribed by the Contract Documents together with the supporting documentation listed herein. Applications for Payment received after the 25th day of each month, or not submitted on an original, or containing erroneous information, or missing the required supporting documentation, shall not be processed during that month's payment cycle. Payments shall be made on the value of Work expected to be completed up to and including the last day of the month based upon the labor and materials incorporated in the Work; and of materials suitably stored at the site; less the aggregate of any previous payments, retainages and amounts withheld under subsection 7.2.1.9. The Applications for Payment, including final payment, shall be reviewed and certified by the College's Project Manager. After reviewing and certifying the amounts due the Contractor, the College's Project Manager will submit the Project Application and the Project Certificate for Payment, along with the Contractor's Applications and Certificates for Payment, to the Architect/Engineer. Based on the Architect/Engineer's observations and valuations of Contractor's Applications for Payment, and the Certifications of the College's Project Manager, the Architect/Engineer will review and certify the amounts due the Contractor and will issue a Project Certificate for Payment.

- (1) The Contractor shall promptly pay each Subcontractor, if any, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's Work, the amount to which each Subcontractor is entitled, reflecting the percentage actually retained, if any, from payments to the Contractor on account of the Subcontractor's Work. The Contractor may not withhold from the Subcontractor any portion of the payment due to any cause unrelated to the Subcontractor's performance of the Work on the Project, notwithstanding any prior agreement between Contractor and Subcontractor to the contrary.

7.2.1.2. No later than the 25th day of each month, each Application for Payment shall be supported by the following documentation, each in a form to be supplied or approved by the College's Project Manager:

- (1) Updated schedule information of Contractor's progress to date, including assessment of progress compared to scheduled completion date.
- (2) Subcontractors' certificates, statements and affidavits showing that portions of the Work covered by the Application for Payment have been completed and material included therein have been and will be delivered.
- (3) Affidavit from Contractor and Subcontractor stating respectively that their subcontractors, vendors and material suppliers have been paid from the proceeds of the last Application for Payment and that there are no outstanding claims for payment.

7.2.1.3. That part of the payment which is requested on account of materials delivered and suitably stored at the site or other approved location but not incorporated in the Work shall, if required by the College's Project Manager, be conditioned upon submission by the Contractor of bills of sale or upon such other procedure as will establish the College's title to such material or otherwise adequately protect the College's interest as determined by the College's Project Manager, including applicable insurance coverage and cost of transportation to the project site for those materials and equipment stored off the site.

7.2.1.4. Provided that the Contractor has furnished acceptable payment and performance security equal to 100% of the Contract Sum, from each Application for Payment the College shall withhold as retainage no more than 5% of the amount earned. Unless otherwise agreed to by the College in writing, the retainage withheld shall be paid within 120 days after satisfactory completion of the Contract or within 120 days after resolution of a dispute or contract claim concerning the satisfactory completion of the Contract, whichever is later. The College reserves the right to withhold from payments otherwise due the Contractor any amount that the College reasonably believes necessary to protect its interest, including, but not limited to, the College concluding in its sole judgment that the Work may not be completed by the date required by the Contract or the Work is otherwise not in conformance with the requirements of the Contract Documents. Following Substantial Completion of the Project, the College in its sole discretion, may authorize reduction of retainage withheld to an amount not less than two (2) times the College's Project Manager's estimate of the value of the Contractor's punch list items.

7.2.1.5. Application for Payment shall be in the format required by the Contract Documents and the College's Project Manager. The Application shall include an itemized breakdown of the various items of the Work based on the previously submitted Schedule of Values.

7.2.1.6. The provisions for payment, withholding, retainage and Certificates of Payments are solely for the benefit of the College, and no other party (including sureties of the Contractor) may assert any claim for negligence or other action against the College, or anyone acting on behalf of the College for waiving or misapplying these provisions.

7.2.1.7. No Certificate issued nor payment made to the Contractor may be construed as an acceptance of the Work or be construed or relied upon as any indication that the labor or materials are in accordance with the Contract Documents or that the amounts paid or certified therefore represent the correct cost or value of the Work or that such amounts are in fact or law due the Contractor.

7.2.1.8. Any Application for Payment which is based on a pending claim for additional compensation may be certified by the College's Project Manager and the Architect/Engineer to the extent that it is determined that the payments yet to be made under the Contract and/or the retainage are sufficient to protect the College. Nothing herein shall be construed as requiring the College's Project Manager and Architect/Engineer to certify such applications or to release retainage. All certifications and payments, including those pursuant to a pending claim, shall be tentative and conditional.

7.2.1.9. The College may withhold payment or, on account of subsequently discovered evidence, nullify or reduce the whole or part of any certificate or payment on account of:

- (1) failure to update schedules properly as required by subsection 3.7;
- (2) failure to furnish the documents required by subsection 7.2.1.1 and 7.2.1.2;
- (3) liquidated damages which may be assessed under the Contract Documents or other damages or compensation due the College for claims of the College against the Contractor;
- (4) the cost (measured by the contract value or fair market value whichever is greater) of completing unfinished or defective Work not remedied or deductions or amounts due the College under the Contract;
- (5) failure of the Contractor to perform any material Contract requirements;
- (6) claims filed or likely to be filed against the College for which the Contractor may be

- liable to the College;
- (7) failure of the Contractor to make payments properly to Subcontractors or suppliers for material or labor or amounts claimed by the Contractor's surety or insurer under any right of subrogation;
- (8) a reasonable doubt the Work can be completed for the residual balance of the Contract;
- (9) damage to another Contractor;
- (10) any claim of the College or debt owed to the College by the Contractor;
- (11) failure to maintain as-built drawings; or
- (12) the cost of completing unfinished warranty Work.

7.3. ACCEPTANCE OF THE WORK AND FINAL PAYMENT

7.3.1. Partial Acceptance

7.3.1.1. If, in its sole discretion, the College desires to occupy any portion of the Work, the College shall have the right to occupy and use those portions of the Work which in the opinion of the College can be used for their intended purpose; provided that the conditions of occupancy and use are established and the responsibilities for the Contractor and the College for maintenance, heat, light, utilities and insurance are mutually agreed to by the Contractor and the College. The College has no obligation to accept the Work in portions. Partial occupancy shall in no way relieve the Contractor of its responsibilities under the Contract.

7.3.1.2. When the College occupies the Work in portions or accepts the Work in portions, if the beneficial use of any accepted portion of the Work as a whole depends on substantial completion or beneficial use of any other portion, then, unless otherwise agreed to by the College in writing: (1) warranties on the accepted portions do not begin to run until substantial completion of all portions on which beneficial use of the whole Work depends, and (2) substantial completion of the whole Work shall not be deemed to be achieved until substantial completion of all portions on which beneficial use of the whole depends.

7.3.2. Substantial Completion and Final Inspection

7.3.2.1. When the Work is substantially completed, the Contractor shall notify the College's Project Manager and Architect/Engineer in writing that the Work will be ready for final inspection and testing on a definite date. Reasonable notice shall be given by the Contractor to permit the College's Project Manager and Architect/Engineer to schedule the final inspection.

7.3.2.2. The inspection shall be conducted by the College's Project Manager and the Architect/Engineer. On the basis of the inspection, if it is determined that the Work appears to be substantially complete and the Work appears to be ready for occupancy and usable for its intended purpose, the College's Project Manager and Architect/Engineer shall establish the date of Substantial Completion, shall fix the times at which the warranties will begin, and the Architect/Engineer shall issue a Certificate of Substantial Completion.

7.3.2.3. If it is determined that Substantial Completion has been achieved, the College's Project Manager shall fix the time within which the Contractor shall complete any remaining items of Work which will be indicated on a list (the "punch list"). If the Contractor fails to complete the remaining items so listed in the time stipulated, the College shall have the undisputed right to complete the Work at the Contractor's expense. The Contractor may be required to complete multiple punch lists until the Contract is performed in its entirety. Failure to complete punch list work in a timely manner shall constitute grounds for termination of the Contract for default. Final payment shall not be made until all Contract work, including all punch list work, is complete to the satisfaction of the College's Project Manager.

7.3.2.4. Acceptance of the Work as substantially complete shall not excuse or waive any failure of the Contractor to complete the Contract as required by the Contract Documents. The Work shall not be considered substantially complete until (1) all electrical, mechanical, and life safety systems shall be completed and successfully tested and successfully inspected for conformity to all requirements of the Contract Documents and all applicable codes and standards, (2) a certificate of occupancy has been obtained for all parts of the Work and (3) all other requirements for substantial completion are met.

7.3.2.5. Upon completion of the Work, the Contractor shall forward to the College's Project Manager a written notice that the Work is ready for final inspection and acceptance and shall also forward to the College's Project Manager a final Application for Payment. The final Application for Payment shall be processed in accordance with Subparagraph 7.3.3. Upon receipt, the College's Project Manager will forward the notice and Application to the Architect/Engineer who with the College's Project Manager will promptly make such inspection. When the Architect/Engineer, based on the recommendation of the College's Project Manager, finds the Work acceptable under the Contract Documents, the Architect/Engineer shall issue a Final Application and Certificate for Payment stating that the Work provided for in the Contract has been completed and is acceptable under the terms and conditions thereof and that the entire balance found to be due to the Contractor and noted in the final application is due and payable. The College's Project Manager and Architect/Engineer may not issue the Final Certificate and Application for Payment until all Work is fully completed and all other obligations of the Contractor under the Contract Documents have been completed.

7.3.3. Application for Final Payment

7.3.3.1. Upon completion of the Work, the Contractor shall prepare and submit to the College's Project Manager an Application for Final Payment. The College's Project Manager and Architect/Engineer will promptly proceed to make any necessary final surveys, to complete any necessary computations of quantities, and to complete other activities necessary to determine the Contractor's right to final payment. The College's Project Manager and Architect/Engineer will certify so much of the Contractor's Application for Final Payment as they consider due. The Contractor shall be informed of all deductions, damages, costs, back-charges, and other charges assessed against the Contractor by the College and the reasons therefore. Notwithstanding what is stated above, prior to or in the absence of a request from the Contractor for final payment, the College may determine the amount of the final payment it considers to be due to the Contractor.

7.3.3.2. If the Contractor disputes the amount determined by the College to be due it, it may initiate a claim under Article 4.4, Claims and Disputes.

7.3.3.3. Acceptance by the Contractor of any payment identified by the College as being a final payment shall operate as an accord and satisfaction and a general release of all claims of the Contractor against the College arising out of or connected with the Contract, except as may be expressly agreed otherwise in writing between the Contractor and the College. No claims by the Contractor may be asserted for the first time after the Contractor submits its Application for Final Payment or after final payment is made by the College.

7.3.3.4. Prior to final payment and before issuance of the College's Project Manager's and Architect/Engineer's final Certificates therefore, the Contractor shall fully comply with the following requirements:

- (1) Cleanup the Work area in accordance with the Specifications and federal, state, bi-county, county and local rules and regulations.
- (2) Provide a notarized affidavit stating that all monetary obligations to suppliers of material, services, labor and all Subcontractors have been completely fulfilled and discharged.
- (3) Complete all punch list Work and furnish to the College's Project Manager all documents, manuals and record (as-built) documents.

7.4. ASSIGNMENT OF CONTRACT MONIES

7.4.1. The Contractor shall not assign any monies due to it under the Contract without the consent of the College, and the assignee in such case shall acquire no rights against the College.

7.5. AUDIT

7.5.1. If the Contractor has submitted any claim or request for additional payment exceeding \$50,000, or If the Contractor has submitted cost or pricing data in connection with the pricing of any modification to this Contract, the College shall have the right to examine and audit all books, records, documents, and other data of the Contractor (including computations and projections) related to negotiating, pricing or performing the modification or claim in order to evaluate the accuracy, completeness, and currency of the cost or pricing data. In addition to the above, the Contractor shall make available to the College the original project price estimate and backup takeoffs and records, and the actual monthly or periodic job cost records. If the Contractor fails or refuses to comply with applicable provisions concerning the Contract changes or claims, the College shall have no obligation to make payment to the Contractor for the change or claim.

7.5.2. The Contractor shall permit audit and fiscal and programmatic monitoring of the Work performed under this Agreement. The Contractor shall make available at its office at all reasonable times, the materials described in subsection 7.5.1, for examination, audit or reproduction, for 3 years after final payment under the Contract.

7.5.3. If the Contract is completely or partially terminated, the records relating to the Work terminated shall be made available for 3 years after any resulting final termination settlement.

7.5.4. Records pertaining to claims, contract disputes, or to litigation or the settlement of claims arising under or relating to the performance of the Contract shall be made available until final disposition of such appeals, litigation, or claims.

ARTICLE 8 – PROTECTION OF PERSONS AND PROPERTY**8.1. SAFETY PRECAUTIONS AND PROGRAMS**

8.1.1. The Contractor shall comply with all applicable laws, ordinances, rules, regulations and lawful orders of any public authority having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss.

8.1.2. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract. Contractor shall comply and cooperate with College safety and security programs.

8.1.3. Except as otherwise directed by the Contract Documents, in the event the Contractor encounters on the site material reasonably believed to be hazardous, including but not limited to asbestos or polychlorinated biphenyl (PCB), which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the College's Project Manager in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the College's Project Manager and Contractor if in fact the material is hazardous and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of hazardous material.

8.2. PROTECTION OF PERSONS AND PROPERTY

8.2.1. The Contractor shall take all necessary precautions to ensure the safety of the public and of workers on the job, and to prevent accidents or injury to any persons on, about, or adjacent to the premises where the Work is being performed. The Contractor shall comply with the "Williams-Steiger Occupational Safety and Health Act of 1970, as amended, and all laws, ordinances, codes, rules and regulations relative to safety and the prevention of accidents, and shall also comply with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America and with the applicable provisions of the American Standard Safety Code for Building Construction, ANSI A 10 Series, unless prevention of accidents is regulated by a more stringent local, State or Federal code, ordinance or law. The Contractor shall erect and properly maintain at all times, as required by laws and regulations and the conditions and progress of the Work, proper safeguards, including minimum provision of six (6) foot fall protection, for the protection of Workers and the public and shall post signs and other warnings against the dangers created by openings, stairways, falling materials, open excavations and all other hazardous or unsafe conditions. It shall be the Contractor's exclusive responsibility to take all safety precautions which may be necessary to protect all persons and property from injury or damage.

8.2.2. Contractor shall request permission in writing of the College's Project Manager, and have received written permission from the College's Project Manager, prior to the storage, use, or transportation onto the campus of explosives or other hazardous materials or equipment required for the execution of the Work. The Contractor is prohibited from storing, using or transporting hazardous materials or equipment not required for the execution of the Work onto the campus. The Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel if such written permission has been granted.

8.2.3. All damage or loss to any property referred to in this section, caused in whole or in part by the Contractor, and Subcontractor, and sub-subcontractor, or anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable, shall be remedied by the Contractor, except damage or loss attributable solely due to faulty Drawings or Specifications or to the acts or omissions of the College or Architect/Engineer or anyone employed by either of them or for whose acts either of them may be liable, and not also attributable to the fault or negligence of the Contractor.

8.2.4. The Contractor shall designate a responsible member of its organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated in writing by the Contractor to the College's Project Manager.

8.2.5. Contractor shall not load or permit any part of the Work to be loaded so as to endanger its safety.

8.2.6. In any emergency affecting the safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Any additional compensation or extension of time claimed by the Contractor on account of emergency Work shall be determined as provided for in these General Conditions.

8.2.7. The Contractor shall continuously protect the Work and the College's property from damage, injury or loss arising in connection with operations under the Contract Documents. It shall make good any such damage, injury or loss, except such as may be caused solely by agents or employees of the College.

8.2.8. The Contractor shall be solely responsible for all damage due to intrusion and for the proper protection of the project site from damage due to fire, rain, wind or other causes. The Contractor shall provide sufficient security personnel as it deems necessary for proper protection of the Work and project site at all times. The Contractor shall provide temporary protection to prevent unauthorized persons from obtaining access to the site during the night and at other non-working hours.

8.2.9. The Contractor shall assume sole responsibility for vandalism or loss of materials and equipment not covered by Contractor's Builder's Risk insurance.

8.2.10. The Contractor shall protect all streets, sidewalks, light poles, hydrants and concealed or exposed utilities of every description affected by or adjacent to the Work and if such items are damaged by the Contractor or Subcontractors, the Contractor shall make all necessary repairs thereto or replacements thereof at no cost to the College.

8.2.11. Tight wood sheathing or plywood shall be laid under any materials that are stored on finished cement surfaces.

8.2.12. The Contractor shall at all times provide and maintain adequate protection against weather so as to preserve all Work, materials, equipment, apparatus and fixtures free from injury or damage.

8.2.13. The Contractor shall provide and maintain adequate protection for all properties adjacent to the site. When required by law or for the safety of the Work, the Contractor shall shore up, brace, underpin and protect as necessary, foundations and other portions of existing structures which are in any way affected by the operations under the Contract Documents. The Contractor, before commencement of any part of the Work, shall give any notices required to be given to an adjoining landowner or other parties.

8.2.14. The Contractor shall confine its construction equipment, the storage of materials and the operations of Workers to the limits indicated by laws, ordinances, permits and as may be established by the College, and shall not unreasonably encumber the premises with construction equipment or material.

8.2.15. The Contractor shall enforce the College's Project Manager's instructions regarding signs, advertisements, fires and smoking.

8.3. FIRE PROTECTION

8.3.1. Adequate precautions shall be taken against fire throughout all the Contractor's and Subcontractors' operations. Flammable material shall be kept at an absolute minimum, and, if any, shall be properly handled and stored. Except as otherwise provided herein, the Contractor shall not permit fires to be built or open salamanders to be used in any part of the Work.

8.3.2. Construction practices, including cutting and welding, and protection during construction shall be in accordance with the published standards of the Industrial Risk Insurers and the National Fire Protection Association; provide a sufficient number of approved portable fire extinguishers, distributed about the project; and use non-freeze type in cold weather.

8.3.3. Gasoline and other flammable liquids shall be stored in and dispensed from Underwriters' Laboratories listed safety containers in conformance with the National Fire Protection Association recommendations. Storage of any flammable liquids, however, shall not be within buildings.

8.3.4. All tarpaulins that may be used for any purpose during construction of the Work shall be made of material which is resistant to fire, water and weather. All tarpaulins shall have the Underwriters' Laboratories approval and shall comply with FS CCC-D-746.

8.3.5. The Contractor shall maintain emergency and fire exits from the Work area, or establish alternative exits satisfactory to the Fire Marshal.

8.3.6. Fire protection and safety during the execution of the Work are the exclusive responsibility of the Contractor.

8.4. EMERGENCIES

8.4.1. In an emergency affecting the safety of life, the Work or adjoining property, the Contractor, without special instructions or authorization from the College's Project Manager, is permitted to act at the Contractor's discretion to prevent such threatened loss or injury. In such an emergency the Contractor shall act prudently and expeditiously to prevent any threatened loss or injury and shall immediately notify the College's Project Manager and the Campus Security Office of such actions.

8.5. ACCIDENTS

8.5.1. The Contractor shall provide at the site, and make available to all workers, medical supplies and equipment necessary to supply first aid service to all persons injured in connection with the Work.

8.5.2. Contractor must promptly report in writing to the College's Project Manager and the Campus Security Office all accidents arising out of, or in connection with, the performance of the Work, whether on or off the site, which caused death, personal injury or property damage, giving full details and statements of witnesses. In addition, if death or serious damages are caused, the accident shall be reported immediately by telephone or messenger. If any claim is made by anyone against the Contractor or any Subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the College's Project Manager and the Campus Security Office, giving full details of the claim.

ARTICLE 9 – INSURANCE AND BONDS

9.1. INSURANCE

9.1.1. Unless otherwise indicated in the Contract Documents, the Contractor shall maintain in force at all times during the term of this Agreement, with an insurance carrier licensed to do business in the State of Maryland acceptable to the College, the following minimum insurance coverage. This insurance must be kept in full force and effect during the term of this contract, including all extensions. The insurance must be evidenced by a certificate of insurance, and if requested by the College, the proposed awardees/Contractor shall provide a copy of the insurance policies. The Contractor's insurance shall be primary.

- a) Worker's Compensation Insurance covering the Contractor's employees as required by State of Maryland law with the following minimum limits:

Bodily Injury by Accident	\$ 100,000 each accident
Bodily Injury by Disease	\$ 500,000 policy limit
Bodily Injury by Disease	\$ 100,000 each employee.

- b) Commercial General Liability Insurance, excluding automobiles owned or hired by the Contractor, with limits as follows:

Bodily Injury and Property Damage:	\$ 10,000,000 combined single limit of bodily injury and property damage per occurrence
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- c) Comprehensive Automobile Liability Insurance, providing bodily injury and property damage coverage for owned vehicles, hired vehicles and non-owned vehicles with limits as follows:

Bodily Injury:	\$ 1,000,000 each person
	\$ 2,000,000 each occurrence
Property Damage:	\$ 2,000,000 each occurrence

- d) Builder's Risk Insurance, providing property damage and theft replacement coverage for goods provided and services rendered during construction. For building renovation projects, when custody of the building is turned over to the Contractor, the Builder's Risk policy must additionally include building replacement value.

- e) Insured - The College, its elected and appointed officials, officers, consultants, agents and employees must be named as an additional insured and loss payee on Contractor's Commercial and Excess/Umbrella Insurance for liability arising out of Contractor's products, goods and services provided under this Agreement.

9.1.2. Prior to the College signing the Contract, the Contractor shall provide the College with evidence of payment for the above insurance coverage. Any agreement for an extension of time to the Contract shall also include evidence of payment for extending the above insurance coverage for that agreed upon period of time.

9.1.3. These coverages and limits are to be considered minimum requirements under this Agreement and shall in no way limit the liability or obligations of the Contractor. The insurance shall provide that policy coverage will not be canceled, altered or materially changed without sixty (60) calendar days' prior notice to the College by registered or certified mail. The insurance shall not be limited to claims made only while the policy is in effect.

9.1.4. The Contractor shall furnish the College with a certificate of insurance as evidence of the required coverage. The certificates of insurance must name the College as an additional insured.

9.1.5. In the event that the Contractor's insurance is terminated, the Contractor shall immediately obtain other coverage and any lack of insurance shall be grounds for immediate termination of this Agreement.

9.1.6. For the purposes of this article, the word "licensed" shall be deemed to mean an insurance carrier either licensed or approved to do business in the State of Maryland.

9.2. PERFORMANCE, LABOR AND MATERIAL BONDS

9.2.1. The College may require the Contractor to furnish bonds. The bonds furnished by the Contractor shall be issued by a surety licensed to conduct business in the State of Maryland. The surety shall be approved by the College. The bonds furnished shall comply in all respects with the requirements of Maryland's Little Miller Act and shall be in the form prescribed by the College.

9.2.2. Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall permit a copy to be made.

9.2.3. If at any time, the surety becomes insolvent, files for bankruptcy or for any reason whatsoever loses its right to do business in the State of Maryland, the Contractor shall, as soon as practicable but no later than within five calendar days, inform the College of this occurrence in writing.

9.2.4. If at any time, the surety becomes insolvent, files for bankruptcy or for any reason whatsoever loses its right to do business in the State of Maryland, the Contractor shall, within ten (10) calendar days after notice from the College to do so, substitute an acceptable bond (or bonds) in such form and sum and signed by such other surety as may be satisfactory to the College.

ARTICLE 10 – CORRECTION OF WORK**10.1. CORRECTION OF WORK****10.1.1. Correction of Work before Final Payment**

10.1.1.1. The Contractor shall promptly remove from the premises all materials, equipment (whether incorporated in the Work or not) and Work rejected by the College's Project Manager as failing to conform to the Contract Documents, and the Contractor shall promptly replace and re-execute all Work under its Contract in accordance with the Contract Documents and without expense to the College and shall bear the expense of making good all Work of other contractors destroyed or damaged by such removal or replacement.

10.1.1.2. If the Contractor fails to correct nonconforming Work and does not proceed with correction of such Work within a reasonable period fixed by written notice from College's Project Manager, the College's Project Manager may remove it and store the salvable materials or equipment at the Contractor's expense. If the Contractor does not pay costs of such removal and storage within ten (10) calendar days after written notice, the College's Project Manager may upon ten (10) additional calendar days written notice sell such materials and equipment at auction or at private sale and shall account for the proceeds thereof, after deducting costs and damages that should have been borne by the Contractor, including compensation for the College's Project Manager's and Architect/Engineer's services and expenses made necessary thereby. If such proceeds of sale do not cover costs which the Contractor should have borne, the Contract sum shall be reduced by the deficiency. If payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the College.

10.1.2. Correction of Work after Final Payment

10.1.2.1. If, within one year, or other time period established in the Contract Documents, after the date of Substantial Completion of the Work or designated portion thereof, any of the Work is found to not be in accordance with the Contract Documents, the Contractor, at its own expense shall correct it promptly after receipt of written notice from the College to do so. The Contractor shall pay for such tests and inspections made necessary by the faulty Work. The Contractor shall pay the costs incurred by the College for professional services and expenses, including but not limited to design professional and College's Project Manager fees, required as a result of Work found not in accordance with the Contract Documents, during the correction period. The correction period shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. This obligation shall survive Final Completion of the Work under the Contract and the Contract Closeout.

10.2. ACCEPTANCE OF NON-CONFORMING WORK

10.2.1. If, in the opinion of the College, it is undesirable to replace any defective or damaged materials or to reconstruct or correct any portion of the Work injured or not performed in accordance with the Contract Documents, the compensation to be paid to the Contractor hereunder shall be reduced by such amount as in the judgment of the College to be equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 11 – MISCELLANEOUS PROVISIONS**11.1. LEGAL OBLIGATIONS, RELATIONS AND RESPONSIBILITIES****11.1.1. Laws to be Observed**

11.1.1.1. The Contractor shall keep fully informed of all Executive Orders, Federal, State, county, bi-county, regional and local laws, ordinances, rules and regulations and all orders and decrees of bodies of tribunals having any jurisdiction or authority, which in any matter affect those engaged or employed on the Work, or which in any way effect the conduct of the Work. It shall at all times observe and comply with all such laws, rules, ordinances, regulations, orders and decrees; it shall protect and indemnify the College and its Project Managers against any such claim or liability arising from or based on the violation of any law, ordinance, regulation, order, or decree, whether by itself or its employees, Subcontractors or suppliers at any tier. Whenever the Contract Documents require the Contractor to comply with provisions of Federal, State or local laws, regulations, ordinances or codes, the Contractor must comply whether such laws, regulations, ordinances or codes are expressly incorporated into the Contract or not.

11.1.1.2. The Contractor must comply with the provisions of the Workers' Compensation Act and Federal, State and local laws relating to hours of labor.

11.1.1.3. This Agreement is a contract under seal and its provisions shall be construed and interpreted according to the laws of the State of Maryland, without regard to principles of conflicts of law.

11.1.1.4. If the Contractor observes that the Contract Documents are at variance with any applicable law, ordinance or regulation, it shall promptly notify the College's Project Manager, and any necessary change shall be adjusted as provided in the Contract for changes in the Work. If the Contractor performs any Work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice, it shall bear all costs arising there from.

11.1.2. Regulations

11.1.2.1. Wherever any provision of any section of the Specifications conflicts with any agreements or regulations of any kind at any time in force among members of any Associations, Unions or Councils, which regulate or distinguish what work shall or shall not be included in the work of any particular, the Contractor shall make all necessary arrangements to reconcile any such conflict without delay, damage or cost to the College and without recourse to the College.

11.1.2.2. In case the progress of the Work is affected by any undue delay in furnishing or installing any items of material or equipment required under the Contract because of a conflict involving any such agreement or regulation, the College's Project Manager and Architect/Engineer may require that other material or equipment of equal kind and quality be provided at no additional cost to the College.

11.2. INDEPENDENT CONTRACTOR

11.2.1. The Contractor shall perform the Contract as an independent contractor and shall not be considered as an agent of the College, nor shall any employee or agent of the Contractor be considered subagents of the College. Nothing in this Contract shall be construed as constituting a partnership, joint venture, or agency between the College and Contractor. Other than duties of the College's Project Manager based on authority granted to the College's Project Manager by the College, no acts performed or representations, whether oral or written, made by or with respect to third parties and the Contractor shall be binding on the College.

11.3. EQUAL OPPORTUNITY

11.3.1. During the performance of this Contract, and in accordance with applicable law, the Contractor shall not discriminate in any manner on the basis of age, sex, race, color, religious belief, national origin, creed, status as a qualified individual with a disability or handicap, pregnancy, marital status or status as a disabled veteran or veteran of the Vietnam era.

11.3.2. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated equally during employment without regard to their age, sex, race, color, religious belief, national origin, creed, status as a qualified individual with a disability or handicap, pregnancy, marital status or status as a disabled veteran or veteran of the Vietnam era. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this non-discrimination clause.

11.3.3. During the performance of this contract, the Contractor agrees that it shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants shall receive consideration for employment without regard to sex, race, age, color, creed, national origin, religious belief, handicap, marital status or status as a disabled veteran or veteran of the Vietnam era. The Contractor further assures the College that, in accordance with the Immigration Reform and Control Act of 1986, it does not and will not discriminate against an individual with respect to hiring, or recruitment or referral for a fee, of the individual for employment or the discharging of the individual from employment because of such individual's national origin or in the case of a citizen or intending citizen, because of such individual's citizenship status.

11.3.4. The Contractor shall comply with all provisions of Executive Order 11246, as amended and of the rules, regulations and relevant orders of the Secretary of Labor.

11.3.5. The Contractor shall furnish all information and reports required by Executive Order 11246, as amended and by the rules, regulations and orders of the Secretary of Labor, or pursuant thereto, and shall permit access to the Contractor's books, records and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.

11.3.6. In the event of the Contractor's noncompliance with the nondiscrimination clauses of the contract or with any of such rules, regulations or orders, this contract may be canceled, terminated or suspended in whole or in part, or the College may take such other action as may be necessary to obtain compliance. If such noncompliance appears continuing, the College may suspend all Contract payments until the noncompliance has ceased. Any delay in completion of the Contract as the result of the College taking action to obtain compliance with the nondiscrimination clauses of this Contract shall not preclude the imposition and collection of the liquidated damages for each day of delay in completion of the Work as provided for elsewhere in the Contract Documents. The Contractor may also be declared ineligible for further contracts with the College in accordance with procedures authorized in Executive Order 11246, as amended. The College's conceptual rights and remedies provided under this section are in addition to any other rights and remedies as provided in Executive Order 11246, as amended or by rule, regulation or order of the Secretary of Labor, or as otherwise provided by law or under this Contract.

11.3.7. Subcontractors shall not be approved by the College without first agreeing to the above terms and conditions, and the Contractor shall include the provisions of subsections (1) through (7) of this section in every subcontract or purchase order unless exempted by rules, regulations or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246, as amended, so that such provisions shall be binding upon each Subcontractor or vendor. The Contractor shall take such action with respect to any Subcontractor or purchase order as the College may direct as a means of enforcing such provisions including sanctions for noncompliance; provided, however, that in the event the Contractor becomes involved in, or is threatened with, litigation with a Subcontractor or vendor as a result of such

direction by the College, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

11.4. COMPLIANCE WITH THE IMMIGRATION REFORM AND CONTROL ACT OF 1986

11.4.1. The Contractor warrants that both the Contractor and/or any subcontractor of the Contractor do not and shall not hire, recruit or refer for a fee, for employment under this Agreement or any subcontract, an alien knowing the alien is an unauthorized alien and hire any individual without complying with the requirements of the Immigration Reform and Control Act of 1986 (hereinafter referred to as "IRCA"), including but not limited to any verification and record keeping requirements. The Contractor agrees to indemnify and save the College, its employees and/or trustees harmless from any loss, costs, damages or other expenses suffered or incurred by the College, its employees and/or trustees by reason of the Contractor's or any subcontractor of the Contractor's noncompliance with "IRCA." The Contractor agrees to defend the College, its employees and/or trustees in any proceeding, action or suit brought against the College, including but not limited to administrative and judicial proceedings, arising out of or alleging noncompliance of the Contractor with "IRCA." The Contractor recognizes that it is the Contractor's responsibility to ensure that all certifications and verifications as required by law are obtained and maintained for the applicable time period.

11.5. ASSURANCE OF NONCONVICTION OF BRIBERY

11.5.1. The Contractor hereby declares and affirms that, to its best knowledge, none of its officers, directors or partners and none of its employees directly involved in obtaining contracts has been convicted of bribery, attempted bribery or conspiracy to bribe under the laws of any state or the Federal Government.

11.6. CONFLICT OF INTEREST

11.6.1. No employee of the College or of the State of Maryland, or any department, commission, agency or branch thereof whose duties as such employee include matters relating to or affecting the subject matter of this Agreement shall, until such time as the Contractor receives final payment, become or be an employee of the party or parties hereby contracting with the College, the State of Maryland, or any department, commission, agency or branch thereof.

11.7. ASSIGNMENT AND SUBCONTRACTING

11.7.1. Neither the College nor the Contractor shall sell, transfer, assign or otherwise dispose of this Agreement or any portion thereof, or its right, title or interest therein, or its obligations there under, without the written consent of the other. A change in membership of the Contractor's firm of one or more officers shall not constitute an assignment.

11.7.2. The Contractor shall not make any contracts for professional services with any other party for furnishing any of the work or services to be performed under this Agreement without the written approval of the College; however, this provision shall not be taken as requiring the approval of the contract of employment between the Contractor and its personnel assigned for the purposes of performing this Agreement.

11.8. CONTINGENT FEES

11.8.1. The Contractor hereby declares and affirms that neither it nor any of its representatives has employed or retained any person, partnership, corporation, or other entity, other than a bona fide employee or agent working for the Contractor, to solicit or secure this Agreement, and that it has not paid or agreed to pay any person, partnership, corporation, or other entity, other than a bona fide employee or agent, any fee or any other consideration contingent on the making of this Agreement.

11.9. MARYLAND PUBLIC INFORMATION ACT

11.9.1. The College is subject to the Maryland Public Information Act, Title 10 of the State Government Article of the Annotated Code of Maryland. Contractor agrees that it will provide any justification as to why any material, in whole or in part, is deemed to be confidential, proprietary information or secrets and provide any justification of why such materials should not be disclosed pursuant to the Maryland Public Information Act.

11.10. TESTING AND INSPECTION

11.10.1. The College may retain, or may require the Contractor to retain, the services of testing/inspection laboratories/firms to perform the tests and make the required inspections and reports during the course of the Work as specified in the various sections of the Specifications or as required by the College in case of questions as to the strength or suitability of materials. However, for the purpose of preparing and testing design concrete mixes, the Contractor will retain the services of a testing laboratory which shall be other than that retained by the College. The Contractor shall also be responsible for all tests as indicated in the Specifications.

11.10.2. Testing/inspection laboratories/firms shall be responsible for conducting and interpreting the tests, shall state in each report whether or not the specimens tested conform to all requirements of the Contract Documents and shall specifically note deviations, if any, from said requirements. All testing/inspection laboratories/firms shall be subject to the College's approval.

11.10.3. The cost of testing services required solely for the convenience of the Contractor in its scheduling and performance of the Work, and the cost of testing services related to remedial operations performed to correct deficiencies in the Work shall be borne by the Contractor.

11.10.4. The Contractor shall furnish to the College's Project Manager samples of all materials and component parts of the Work required as test specimens in connection with the specified tests, and shall furnish labor and facilities at the site as necessary in connection with testing and inspection services whether such services are performed at the expense of the College or the Contractor.

11.10.5. The nature and scope of testing services performed by an agency retained by the Contractor shall be in accordance with requirements of governing authorities having jurisdiction over the Work and as otherwise specified, and shall be consistent with reasonable standards of engineering practice.

11.10.6. If, in the performance of any testing, control, balancing, adjusting or similar activities to be performed by the Contractor or an agent of the Contractor, it is the opinion of the College's Project Manager that the Contractor or said agent has failed to substantiate its ability to perform such work, the Contractor shall, at its expense, retain the services of a testing laboratory or service organization which is satisfactory to the College's Project Manager for the performance of such work.

11.11. NO WAIVER OF RIGHTS – COLLEGE'S REMEDIES CUMULATIVE – COLLEGE'S DAMAGES

11.11.1. The College shall not be precluded or estopped by any measurement, estimate, change order, contract modification, certificate of payment, or payment from showing the true amount and character of the Work furnished by the Contractor, or from showing that any measurement, estimate, change order, contract modification, certificate of payment, or payment is untrue or was incorrectly made, or from showing that the Work does not in fact conform to the Contract Documents. The College may recover from the Contractor or its sureties, or both, such damages, loss or additional expense incurred as a result of any such error or measurement, estimate, change order, contract modification, certificate of payment, or payment as a result of such failure to conform to the Contract Documents. The College's right in this respect shall not be waived or barred by any inspection, acceptance or approval of the Work, or by payment therefore, or by granting an extension of time, or by taking possession, or by execution of a change order based on the erroneous measurement, estimate, or change order, contract modification, certificate of payment or payment.

11.11.2. The activities of the College's Project Manager, Architect/Engineer and the College respecting this Contract, including inspection of the Work, review of submittals, monitoring of progress, and so forth, are for the benefit of the College only and are not for the benefit of the Contractor. The College's failure to bring to the attention of the Contractor deficiencies in the Work or in the Contractor's performance will not constitute a waiver or excuse of the Contractor's failure to comply strictly with contract requirements.

11.11.3. The waiver by the College of any breach of contract by the Contractor shall not operate as a waiver of any other or subsequent breach.

11.11.4. The rights and remedies of the College and the obligations of the Contractor under various provisions of the Contract Documents and under provisions of the law are cumulative and not exclusive.

11.11.5. For any claim or cause of action accruing to the College as a result of or arising out of this Contract, the College may collect damages of any kind, including consequential damages, or damages for purely economic loss.

ARTICLE 12 – TERMINATION OF THE CONTRACT**12.1. TERMINATION FOR DEFAULT**

12.1.1. The performance of the work or services under this Agreement may be terminated by the College, in whole or in part, from time to time, effective upon receipt of notice, whenever the Contractor shall default in the performance of this Agreement and fails to make progress in the prosecution of the contract work or endangers such performance and shall fail to cure such default within ten (10) calendar days period after receipt of written notification from the College specifying the default.

12.1.2. The College may terminate the Contract if the Contractor;

12.1.2.1. persistently or repeatedly refuses or fails to supply enough properly skilled Workers or materials;

12.1.2.2. fails to make payment to Subcontractors for materials or labor in accordance with their respective agreements between the Contractor and the Subcontractors;

12.1.2.3. persistently disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction;

12.1.2.4. refuses or fails to prosecute the Work, or any separable part thereof with such diligence as shall ensure its completion within the time specified in the Contract or in the extension thereof;

12.1.2.5. fails to complete the Work within the time allotted by the Contract; or

12.1.2.6. is in breach of any material obligation of the Contract, including a breach which may occur after substantial completion.

12.1.3. If any of the above reasons exist, the College may without prejudice to any other rights or remedies of the College and after giving the Contractor and the Contractor's surety, if any, seven days written notice, terminate the employment of the Contractor and may, subject to any rights of the surety:

12.1.3.1. take possession of the site and all materials, equipment, tools, and construction equipment and machinery owned by the Contractor; and

12.1.3.2. finish the Work by whatever reasonable means the College may deem is in its interests.

12.1.4. When the College terminates the Contract for one of the reasons stated herein, the Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Sum exceeds the cost to finish the Work, such excess shall be applied to the Contractor's unreimbursed costs, if any, accrued from the last payment prior to termination to time of termination. This amount shall become due to the Contractor. Any unreimbursed costs exceeding the difference of unpaid balance of the Contract Sum and the cost to finish the Work shall be lost to the Contractor. If the cost to finish the work exceeds the Contract Sum, the Contractor shall pay the difference to the College. The amount to be paid to the Contractor or College, as the case may be, shall survive termination of the Contract.

12.2. TERMINATION FOR CONVENIENCE

12.2.1. The College may, at any time, terminate the Contract in whole or in part for the College's convenience and without cause.

12.2.2. Upon receipt of written notice from the College of such termination for the College's convenience, the Contractor shall (1) cease operations as directed by the College in the notice; (2) take actions necessary, or that the College may direct, for the protection and preservation of the Work; and (3) except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

12.2.3. In the case of such termination for the College's convenience, the Contractor shall be entitled to receive payment from the College for all expenses incurred by it for satisfactory work, including reasonable termination expenses. Upon satisfactory proof that the Contractor would have earned a profit for Work performed prior to the date of termination, the Contractor shall be paid a reasonable amount for profit not to exceed 10% of the Contractor's costs incurred. Under no circumstances shall the Contractor be entitled to payment for anticipated but unearned profit and damages. In no event shall the Contractor's cost of the Work and profit, if any, to be reimbursed exceed the Contract Sum as adjusted by approved change orders.

END OF GENERAL CONDITIONS

SUPPLEMENTARY CONDITIONS

Science West Renovation Rockville Campus

PART 1 – COMPLEX STRUCTURES

- 1.1 With regard to section 007200, General Conditions, paragraph 3.1.2., Contractor is advised that the City of Rockville Complex Structures process applies to this project.

PART 2 – CONTRACTOR’S ADMINISTRATION AND SUPERVISION OF THE WORK

- 2.1 With regard to section 007200, General Conditions, paragraph 3.2.1.1., Contractor shall add subparagraph (a), as follows:

- (a) In addition to satisfying obligations to provide competent, qualified and adequate staff, the College expects the Contractor’s core management staff to include, at a minimum, the following personnel roster at the percentage of time rates indicated, from the start of work through Final Completion:

Project Executive	30%
Senior Project Manager	100%
Senior Superintendant	100%
Assistant Project Manager/Engineer	100%
Quality Control Manager	100%
Commissioning Manager	25% at start of work increasing to 100% at commencement of pre-functional testing

PART 3 – PREVAILING WAGE RATES

- 3.1 With regard to section 007200, General Conditions, paragraph 3.3.1.3., Contractor is advised that Prevailing Wage Rates prescribed by the Maryland Department of Labor, Licensing and Regulation (DLLR) apply to this project. The project specific wage rate instructions are enclosed with this section of the contract documents.

PART 4 – OR EQUAL/SUBSTITUTIONS

- 4.1 With regard to section 007200, General Conditions, paragraphs 3.3.3.2. and 3.3.4.3., Contractor is advised that ‘Or Equal’ submittals and Substitution requests shall be accompanied by detail sufficient to facilitate the College’s. To these paragraphs add the following requirement:

“A direct comparison of features and fit with the specified item must be included.”

PART 5 – WARRANTY/GUARANTEES

- 5.1 With regard to section 007200, General Conditions, paragraph 3.4.1.5, first sentence, following “the Contractor shall...” and before the word “re-execute...” please insert the phrase “...manage all warranty callbacks...”.

PART 6 – CONFORMANCE DOCUMENTS

- 6.1 At section 007200, General Conditions, paragraph 3.8, add the following:

“3.8.0. Conformance Documents

3.8.0.1 The College may issue conformance documents, incorporating all Addenda issued during the bid/proposal period into the Contract Documents, for the Contractor’s convenience at the start of Work. It is the Contractor’s sole responsibility to verify the accuracy of the conformance documents. At the Contractor’s election, conformance documents may serve as the basis for Progress Documents. Use of such documentation shall not in any way relieve the Contractor from its responsibility to perform the Work in accordance with the Contract Documents. In the event of a discrepancy between the conformance documents and the Contract Documents, the Contract Documents shall govern.”

PART 7 – COORDINATION WITH ADJACENT OCCUPIED BUILDING

- 7.1 At section 007200, General Conditions, paragraph 3.10.3, add the following:

“3.10.3.3. Provide a detailed Adjacent Work Coordination Plan indicating schedule of activities, limits of disturbance, sequence of construction, access points, barriers, interface with controls such as fire alarm, and building automation systems operation for areas that directly interface with or are affected by the Work.

PART 8 – UTILITY MAPPING

- 8.1 At section 007200, General Conditions, paragraph 3.10.5.5., replace paragraph 3.10.5.5. as follows:

“3.10.5.5. All underground utility locations associated with the scope of work, or revealed during the conduct of the work, including the location, size and material of all water, sanitary sewer, storm sewer, gas, electric, telephone, cable television, duct banks, steam and chilled water utilities within the project area, shall be recorded by the Contractor’s surveyor and referenced to a campus benchmark provided by the College, which is in Maryland State Plane NAD83(NSRS2007) horizontal datum, NAVD88 vertical datum.

Indicate rim and invert elevation of sanitary sewers, storm sewers and stormwater management structures. For all sub-surface utility lines on the site, locate the first connection to the off-site system. The horizontal and vertical location of all subsurface utilities must be measured directly prior to backfill. Locations shall be recorded on project progress documents. Electronic record documentation, in Autocad format, is required at project close-out.”

PART 9 – SCHEDULE

- 9.1 At section 007200, General Conditions, paragraph 7.2.1.2., add the following to the end of the sentence (1):

“..., including assessment of progress compared to scheduled completion date.”

PART 10 – BONDS

- 10.1 At section 007200, General Conditions, replace paragraph 9.2.2 with the following:

“9.2.2. Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall permit a copy to be made.”

End of Supplementary Conditions



STATE OF MARYLAND

DEPARTMENT OF LABOR, LICENSING AND REGULATION
DIVISION OF LABOR AND INDUSTRY
PREVAILING WAGE SECTION
1100 N. Eutaw Street, Room 607
Baltimore, MD 21201
(410) 767-2342

02/17/2014

REQUEST FOR ADVERTISEMENT AND NOTICE TO PROCEED

Yu Zhu - Procurement Officer
Montgomery College
40 West Gude Drive
Rockville, MD 20850

Re: Renovation of Science West Building on the Rockville Campus
Project No: CC-14-MC-414

Enclosed please find the Prevailing Wage Determination and Instructions for Contractors for the project referenced above.

Upon advertisement for bid or proposal of this project, you are requested to submit to this office the date and name of publication in which such advertisement appeared.

Once awarded, you are further directed to submit to this office, the NOTICE TO PROCEED for the project, complete with the date of notice, the name of the general contractor, and the dollar amount of the project. In addition, we ask that a representative of the prevailing wage Unit be invited to attend the Pre-Construction Conference.

Any questions concerning this matter may be referred to PrevailingWage@dllr.state.md.us

Sincerely,

Enclosures
Wage Determination
Instruction for the Contractor

C. Edward Poarch, II
Supervisor
Prevailing Wage Unit

PREVAILING WAGE INSTRUCTIONS FOR THE CONTRACTOR & SUBCONTRACTOR

The contractor shall electronically submit completed copies of certified payroll records to the Commissioner of Labor & Industry, Prevailing Wage Unit by going on-line to <http://www.dllr.state.md.us/prevwage> and following the instructions for submitting payroll information (NOTE: A contractor must register prior to submitting on-line certified payroll information).

If you have technical questions regarding electronic submittal, contact the Department at prevailingwage@dllr.state.md.us.

All certified payroll records shall have an accurate week beginning and ending date. The contractor shall be responsible for certifying and submitting to the Commissioner of Labor and Industry, Prevailing Wage Unit all of their subcontractors' payroll records covering work performed directly at the work site. By certifying the payroll records, the contractor is attesting to the fact that the wage rates contained in the payroll records are not less than those established by the Commissioner as set forth in the contract, the classification set forth for each worker or apprentice conforms with the work performed, and the contractor or subcontractor has complied with the provisions of the law.

A contractor or subcontractor may make deductions that are (1) required by law; (2) required by a collective bargaining agreement between a bona fide labor organization and the contractor or subcontractor; or (3) contained in a written agreement between an employee and an employer undertaken at the beginning of employment, if the agreement is submitted by the employer to the public body awarding the public work and is approved by the public body as fair and reasonable.

A contractor or subcontractor is required to submit information on-line on their fringe benefit packages including a list of fringe benefits for each craft employed by the contractor or subcontractor, by benefit and hourly amount. Where fringe benefits are paid in cash to the employee or to an approved plan, fund, or program, the contribution is required to be indicated.

Payroll records must be electronically submitted and received within 14 calendar days after the end of each payroll period. If the contractor is delinquent in submitting payroll records, processing of partial payment estimates may be held in abeyance pending receipt of the records. In addition, if the contractor is delinquent in submitting the payroll records, the contractor shall be liable to the contracting public body for liquidated damages. The liquidated damages are \$10.00 for each calendar day the records are late.

Only apprentices registered with the Maryland Apprenticeship and Training Council shall be employed on prevailing wage projects. Apprentices shall be paid a percentage of the determined journey person's wage for the specific craft.

Overtime rates shall be paid by the contractor and any subcontractors under its contracts and agreements with their employees which in no event shall be less than time and one-half the prevailing hourly rate of wages for all hours worked in excess of ten (10) hours in any one calendar day; in excess of forty (40) hours per workweek; and work performed on Sundays and legal holidays.

Contractors and subcontractors employing a classification of worker for which a wage rate was not issued SHALL notify the Commissioner of Labor & Industry, Prevailing Wage Unit, for the purpose of obtaining the wage rate for said classification PRIOR TO BEING EMPLOYED on the project. To obtain a prevailing wage rate which was NOT listed on the Wage Determination, a contractor or subcontractor can look on the DLLR webpage under prevailing wage.

Contractors and subcontractors shall maintain a valid copy of proper State and county licenses that permit the contractor and a subcontractor to perform construction work in the State of Maryland. These licenses must be retained at the worksite and available for review upon request by the Commissioner of Labor and Industry's designee.

Under the Maryland Apprenticeship and Training Council requirements, consistent with proper supervision, training and continuity of employment and applicable provisions in collective bargaining agreements, a ratio of one journey person regularly employed to one apprentice shall be allowed. No deviation from this ratio shall be permitted without prior written approval from the Maryland Apprenticeship and Training Council.

Laborers may NOT assist mechanics in the performance of the mechanic's work, NOR USE TOOLS peculiar to established trades.

ALL contractors and subcontractors shall employ only competent workers and apprentices and may NOT employ any individual classified as a HELPER or TRAINEE on a prevailing wage project.

The State Apprenticeship and Training Fund (Fund) law provides that contractors and certain subcontractors performing work on certain public work contracts are required to make contributions toward apprenticeship. See §17-601 through 17-606, State Finance and Procurement, Annotated Code of Maryland. Contractors and subcontractors have three options where they can choose to make their contributions: (1) participate in a registered apprenticeship training program; (2) contribute to an organization that has a registered apprenticeship training program; or (3) contribute to the State Apprenticeship and Training Fund.

The Department of Labor, Licensing and Regulation (DLLR) is moving forward with final adoption of regulations. The regulations were published in the December 14, 2012 edition of the Maryland Register.

IMPORTANT: Please note that the obligations under this law will become effective on JULY 1, 2013. This law will require that contractors and certain subcontractors make contributions toward apprenticeship and report those contributions on their certified payroll records that they submit pursuant to the prevailing wage law.

The Department is offering outreach seminars to any interested parties including contractors, trade associations, and any other stakeholders. Please contact the Department at prevailingwage@dllr.state.md.us or (410) 767-2968 for seminar times and locations. In addition, information regarding this law will be provided at pre-construction meetings for projects covered by the Prevailing Wage law.

**For additional information, contact:
Division of Labor and Industry
Maryland Apprenticeship and Training
1100 North Eutaw Street, Room 606
Baltimore, Maryland 21201
(410) 767-2246
E-Mail Address: matp@dllr.state.md.us.**

STATE OF MARYLAND

**DEPARTMENT OF LABOR, LICENSING AND REGULATION
DIVISION OF LABOR AND INDUSTRY
PREVAILING WAGE SECTION
1100 N. Eutaw Street, Room 607
Baltimore, MD 21201
(410) 767-2342**

The wage rates to be paid laborers and mechanics for the locality described below is announced by order of Commissioner of Labor and Industry.

It is mandatory upon the successful bidder and any subcontractor under him, to pay not less than the specific rates to all workers employed by them in executing contracts in this locality. Reference: Annotated Code of Maryland State Finance and Procurement, Section 17-201 thru 17-226.

These wage rates were taken from the locality survey of 2013 for Montgomery County, issued pursuant to the Commissioner's authority under State Finance and Procurement Article Section 17-209, Annotated Code of Maryland or subsequent modification.

****Note:** If additional Prevailing Wage Rates are needed for this project beyond those listed below, contact the Prevailing Wage Unit. Phone: (410) 767-2342, email: prevailingwage@dllr.state.md.

Name and Title of Requesting Officer: Yu Zhu - Procurement Officer
 Department, Agency or Bureau: Montgomery College
 40 West Gude Drive Rockville, MD 20850

Project Number CC-14-MC-414

Location and Description of work:

Montgomery County: This 69,571 GSF project includes renovation of existing two story building and the addition of third floor. The building will contain a math/science center, classrooms, class labs, a math emporium, an open study area, a lecture hall and an administrative suite. The project expects to achieve LEED Gold certification.

Determination Number 19655

Date of Issue: Feb 17, 2014

BUILDING CONSTRUCTION

CLASSIFICATION	MODIFICATION REASON	BASIC HOURLY RATE	BORROWED FROM	FRINGE BENEFIT PAYMENT
BALANCING TECHNICIAN	AD	\$39.39		\$14.91
BOILERMAKER	AD	\$26.67		\$3.44
BRICKLAYER	AD	\$27.89		\$8.42
CARPENTER	AD	\$26.81		\$8.19
CARPENTER - SHORING SCAFFOLD BUILDER	AD	\$26.81		\$8.19
CARPET LAYER	AD	\$26.81		\$8.19
CEMENT MASON	AD	\$21.28		\$3.44
COMMUNICATION INSTALLER TECHNICIAN	AD	\$23.20	033	\$6.80 a + b
DRYWALL - SPACKLING, TAPING, & FINISHING	AD	\$24.89		\$8.97
ELECTRICIAN	AD	\$40.00		\$14.41
ELEVATOR MECHANIC	AD	\$39.96		\$28.68
FIRESTOPPER	AD	\$26.06		\$6.17
GLAZIER	AD	\$29.64		\$9.64

INSULATION WORKER	AD	\$33.13		\$13.72
IRONWORKER - FENCE ERECTOR	AD	\$34.83		\$16.44
IRONWORKER - ORNAMENTAL	AD	\$30.00		\$16.04
IRONWORKER - REINFORCING	AD	\$26.75		\$17.65
IRONWORKER - STRUCTURAL	AD	\$30.00		\$16.04
LABORER - AIR TOOL OPERATOR	AD	\$17.22		\$7.26
LABORER - BLASTER - DYNAMITE	AD	\$17.22		\$7.26
LABORER - BURNER	AD	\$17.22		\$7.26
LABORER - COMMON OR UNSKILLED	AD	\$15.05		\$0.00
LABORER - CONCRETE PUDDLER	AD	\$17.22		\$7.26
LABORER - CONCRETE SURFACER	AD	\$17.22		\$7.26
LABORER - CONCRETE TENDER	AD	\$17.22		\$7.26
LABORER - CONCRETE VIBRATOR	AD	\$17.22		\$7.26
LABORER - DENSITY GAUGE	AD	\$17.22		\$7.26
LABORER - GRADE CHECKER	AD	\$17.22		\$7.26
LABORER - HAND ROLLER	AD	\$17.22		\$7.26
LABORER - HAZARDOUS MATERIAL HANDLER	AD	\$17.22		\$7.26
LABORER - JACKHAMMER	AD	\$17.22		\$7.26
LABORER - LANDSCAPING	AD	\$17.34	033	\$7.26
LABORER - LAYOUT	AD	\$17.22		\$7.26
LABORER - MASON TENDER	AD	\$17.22		\$7.26
LABORER - MORTAR MIXER	AD	\$17.22		\$7.26
LABORER - PIPELAYER	AD	\$17.22		\$7.26
LABORER - PLASTERER - HANDLER	AD	\$17.22		\$7.26
LABORER - SCAFFOLD BUILDER	AD	\$17.22		\$7.26
LABORER - TAMPER	AD	\$17.22		\$7.26
MILLWRIGHT	AD	\$31.59		\$8.58
PAINTER	AD	\$24.89		\$8.97
PILEDRIVER	AD	\$26.62		\$8.18
PLASTERER	AD	\$27.00	033	\$5.95
PLASTERER - MIXER	AD	\$21.82	033	\$7.26
PLUMBER	AD	\$38.17		\$16.09 a
POWER EQUIPMENT OPERATOR - ASPHALT DISTRIBUTOR	AD	\$26.35	033	\$10.32
POWER EQUIPMENT OPERATOR - BACKHOE	AD	\$32.89		\$9.11
POWER EQUIPMENT OPERATOR - BOBCAT	AD	\$32.40		\$9.11
POWER EQUIPMENT OPERATOR - BOOM TRUCK	AD	\$28.29		\$12.41
POWER EQUIPMENT OPERATOR - BROOM / SWEEPER	AD	\$28.29		\$12.41
POWER EQUIPMENT OPERATOR - BULLDOZER	AD	\$22.00		\$0.00
POWER EQUIPMENT OPERATOR - CONCRETE PUMP	AD	\$34.00		\$3.44
POWER EQUIPMENT OPERATOR - CRANE	AD	\$33.78		\$9.80
POWER EQUIPMENT OPERATOR - CRANE - TOWER	AD	\$33.20		\$3.44
POWER EQUIPMENT OPERATOR - DRILL - RIG	AD	\$33.96		\$9.11
POWER EQUIPMENT OPERATOR - DRILLER	AD	\$33.96		\$9.11
POWER EQUIPMENT OPERATOR - EXCAVATOR	AD	\$24.00		\$3.44
POWER EQUIPMENT OPERATOR - FORKLIFT	AD	\$32.89		\$9.11
POWER EQUIPMENT OPERATOR - GRADER	AD	\$23.64		\$3.38
POWER EQUIPMENT OPERATOR - HOIST	AD	\$24.68		\$12.97
POWER EQUIPMENT OPERATOR - LOADER	AD	\$23.34	033	\$7.00
POWER EQUIPMENT OPERATOR - MECHANIC	AD	\$32.89		\$9.11
POWER EQUIPMENT OPERATOR - MILLING MACHINE	AD	\$16.00	033	\$3.11

POWER EQUIPMENT OPERATOR - PAVER	AD	\$20.80		\$4.58
POWER EQUIPMENT OPERATOR - ROLLER - ASPHALT	AD	\$22.02	033	\$10.70
POWER EQUIPMENT OPERATOR - ROLLER - EARTH	AD	\$33.08		\$0.51
POWER EQUIPMENT OPERATOR - SCRAPER	AD	\$19.00		\$3.44
POWER EQUIPMENT OPERATOR - TRENCHER	AD	\$34.60	013	\$16.01 a + b
RESILIENT FLOOR	AD	\$21.60	033	\$13.40
ROOFER/WATERPROOFER	AD	\$27.70		\$10.38
SHEETMETAL WORKER	AD	\$39.93		\$15.52
SPRINKLERFITTER	AD	\$30.53		\$17.87
STEAMFITTER/PIPEFITTER	AD	\$37.77		\$18.22 a
STONE MASON	AD	\$27.89		\$8.42
TILE & TERRAZZO FINISHER	AD	\$20.48		\$8.84
TILE & TERRAZZO MECHANIC	AD	\$25.29		\$9.99
TRUCK DRIVER - CONCRETE PUMP	AD	\$33.96	033	\$2.96
TRUCK DRIVER - DUMP	AD	\$12.00	033	\$0.00
TRUCK DRIVER - DUMP - ARTICULATING	AD	\$19.64	025	\$1.94
TRUCK DRIVER - LOWBOY	AD	\$20.00	021	\$6.70
TRUCK DRIVER - TANDEM	AD	\$21.00	033	\$2.63
TRUCK DRIVER - WATER	AD	\$21.06	021	\$4.52

FRINGE REFERENCES AS NOTED:

- a. PAID HOLIDAYS: New Year Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day & Christmas Day.
- b. PAID VACATIONS: Employees with 1 year service - 1 week paid vacation;
2 years service - 2 weeks paid vacation;
10 years service - 3 weeks paid vacation.

These **Informational Prevailing Wage Rates** may not be substituted for the requirements of pre-advertisement or onsite job posting for a public work contract that exceeds \$500,000 in value and either of the following criteria are met: (1) the contracting body is a unit of State government or an instrumentality of the State and there is any State funding for the project; or (2) the contracting body is a political subdivision, agency, person or entity (such as a county) and the State funds 50% or more of the project.

Modification Codes:

- (AD) 17-209 Annual Determination from Survey Wage Data Received
(CH) 17-211 Commissioners' Hearing
(CR) 17-208 Commissioners' Review
(SR) 17-208 Survey Review by Staff

Each "Borrowed From" county is identified with the FIPS 3-digit county code unique for the specific jurisdiction in Maryland.

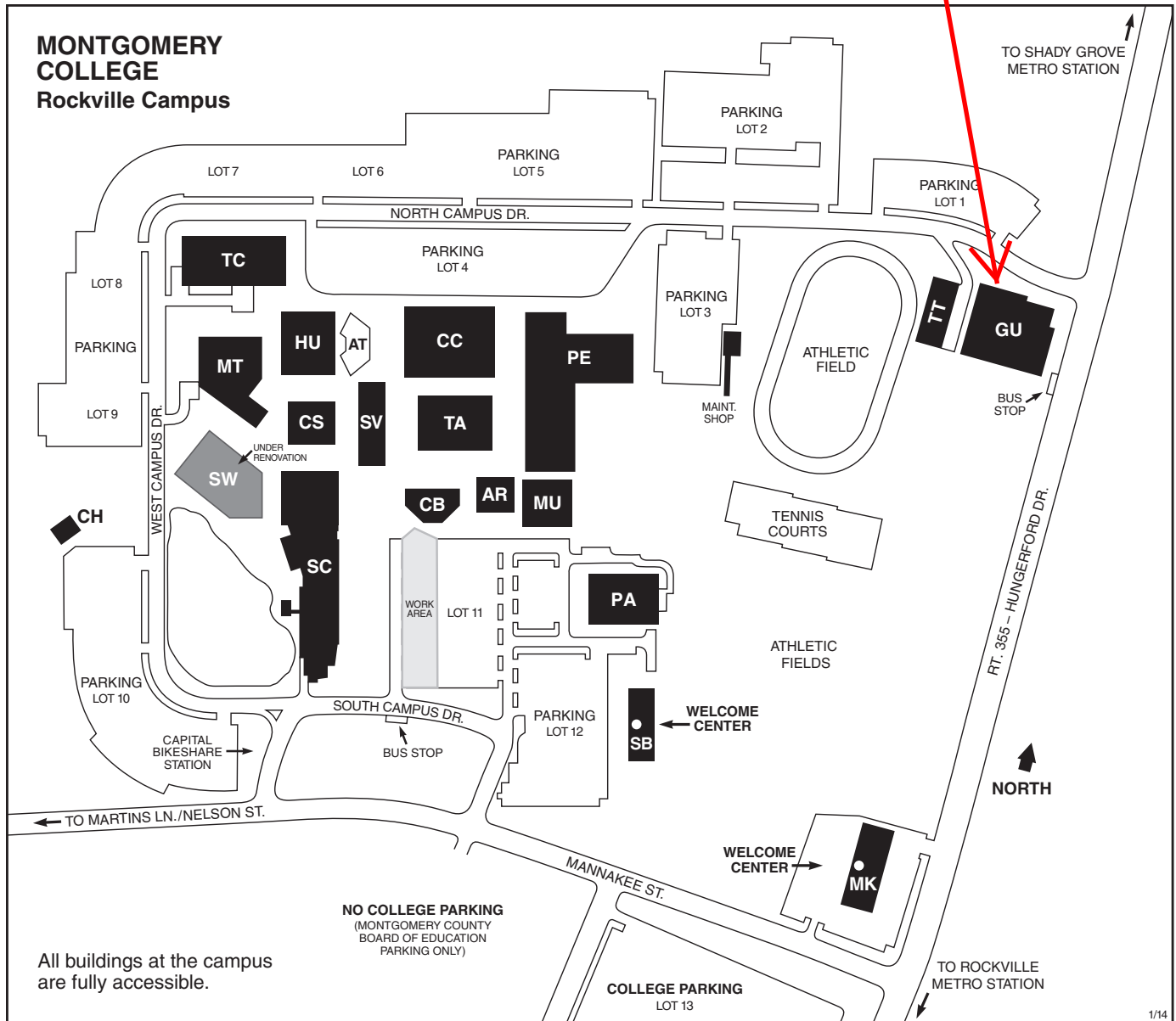
For additional information on the FIPS (Federal Information Processing Standard) code, see <http://www.census.gov/datamap/fipslist/AllSt.txt>

The Prevailing Wage rates appearing on this form were originally derived from Maryland's annual Wage Survey. The Commissioner of Labor & Industry encourages all contractors and interested groups to participate in the voluntary Wage Survey, detailing wage rates paid to workers on various types of construction throughout Maryland.

A mail list of both street and email addresses is maintained by the Prevailing Wage Unit to enable up-to-date prevailing wage information, including Wage Survey notices to be sent to contractors and other interested parties. If you would like to be included in the mailing list, please forward (1) your Name, (2) the name of your company (if applicable), (3) your complete postal mailing address, (4) your email address and (5) your telephone number to PWMAILINGLIST@dllr.state.md.us. Requests for inclusion can also be mailed to: Prevailing Wage, 1100 N. Eutaw Street - Room 607, Baltimore MD 21201-2201.

MONTGOMERY COLLEGE Rockville Campus Map

Informational meeting in Room 224



Montgomery College Rockville Campus

51 Mannakee Street
Rockville, MD 20850
240-567-5000
TTY 301-294-9672

montgomerycollege.edu

For updates to campus maps, visit
montgomerycollege.edu/maps.

Rockville Campus Legend of Buildings

(as of January 2014)

AR Paul Peck Art Building
AT Amphitheatre

CB Counseling and Advising Building
▪ Security Office

CC Campus Center
▪ Workforce Development & Continuing Education Office (WD&CE)

CH Child Care Center

CS Computer Science Building

GU Homer S. Gudelsky Institute for Technical Education

HU Humanities Building

MK Mannakee Building
▪ Central Services
▪ Welcome Center

MT Gordon and Marilyn Macklin Tower

MU Music Building

PA Robert E. Parilla Performing Arts Center

PE Physical Education Center

SB South Campus Instruction Building
▪ Welcome Center

SC Science Center

SV Student Services Building
▪ Admissions Office

SW Science West Building (under renovation)

TA Theatre Arts Building

TC Technical Center

TT Interim Technical Training Center



Montgomery College
endless possibilities

**Montgomery College - Rockville Campus
Science West Renovation & Addition**

Reference Documents, Not for Bid

Specifications – Volume II (2 of 4)

February 19, 2014

MHEC Project No. CC-01-414

MC Contract No. 533

Stantec Project No: 218310092

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SECTION 011000

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

- A. Project Identification: Montgomery College – Rockville Campus, Rockville, Maryland.
- B. Project Summary:
 - 1. Site improvements in the immediate vicinity of the complex. Extended site work includes a new emergency generator near Science East and the installation of direct buried utilities.
 - a. All existing campus fire access roads and lanes shall be maintained for the entire construction duration.
 - 2. Exterior Building Renovation: Complete replacement of the building envelope. The quality and finish will be composed of masonry, metal panels and curtain wall assemblies that are compatible with the adjacent Science East and Science Center buildings. The pedestrian bridge connecting to Macklin Tower will also be replaced, and a new bridge connection to Science East will be added.
 - 3. Interior Building Renovations: Complete replacement of the building's mechanical, electrical, plumbing, fire protection and technology systems, as well as all interior partitions. Additionally, the scope will include the removal and replacement of a large portion of the first floor slab, and the demolition and replacement of existing Stair numbers 1 and 2.
 - 4. New Construction: Addition of a third floor with associated roof, new elevator and third stair tower.
 - 5. Construction phasing
- C. Particular Project Requirements:
 - 1. Existing site conditions and restrictions
 - 2. Requirements for sequencing
 - 3. Hazardous waste abatement
 - 4. Owner-purchased, Owner-installed items
 - 5. Owner-purchased, Contractor-installed items
 - 6. Occupancy of adjacent facilities
 - 7. Contractor's use of new and existing facilities
 - 8. USGBC LEED certification
- D. Permits and Fees: Apply for, obtain, and pay for permits, fees, and utility company backcharges required to perform the work. Submit copies to Architect.
- E. Codes: Comply with applicable codes and regulations of authorities having jurisdiction. Submit copies of inspection reports, notices and similar communications to Architect.

- F. Dimensions: Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.
- G. Existing Conditions: Notify Architect of existing conditions differing from those indicated on the drawings. Do not remove or alter structural components without prior written approval.
- H. Coordination:
 - 1. Coordinate the work of all trades.
 - 2. Prepare coordination drawings for areas above ceilings where close tolerances are required between building elements and mechanical and electrical work.
 - 3. Verify location of utilities and existing conditions.
- I. Installation Requirements, General:
 - 1. Inspect substrates and report unsatisfactory conditions in writing.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.
 - 3. Take field measurements prior to fabrication where practical. Form to required shapes and sizes with true edges, lines and angles. Provide inserts and templates as needed for work of other trades.
 - 4. Install materials in exact accordance with manufacturer's instructions and approved submittals.
 - 5. Install materials in proper relation with adjacent construction and with proper appearance.
 - 6. Restore units damaged during installation. Replace units which cannot be restored at no additional expense to the Owner.
 - 7. Refer to additional installation requirements and tolerances specified under individual specification sections.
- J. Limit of Use: Limit use of work as indicated. Keep driveways and entrances clear.
- K. Existing Construction: Maintain existing building in a weathertight condition. Repair damage caused by construction operations. Protect building and its occupants.
- L. Definitions:
 - 1. Provide: Furnish and install, complete with all necessary accessories, ready for intended use. Pay for all related costs.
 - 2. Approved: Acceptance of item submitted for approval. Not a limitation or release for compliance with the Contract Documents or regulatory requirements. Refer to limitations of 'Approved' in General and Supplementary Conditions.
 - 3. Match Existing: Match existing as acceptable to the Owner.
- M. Intent: Drawings and specifications are intended to provide the basis for proper completion of the work suitable for the intended use of the Owner. Anything not expressly set forth but which is reasonable implied or necessary for proper performance of the project shall be included.
- N. Writing Style: Specifications are written in the imperative mode. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, 'Provide tile' means 'Contractor shall provide tile.'

PART 2 EXECUTION - Not Applicable To This Section

END OF SECTION

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

- A. Unit price is an amount proposed by bidders, stated on the Price Proposal Form, as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A list of unit prices is included in Price Proposal Form 004213B. Specification Sections referenced in the list contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Price Proposal Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

- 1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included in Price Proposal Form 004213B. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012300

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Administrative and supervisory personnel.
 - 2. Coordination Drawings.
 - 3. Project meetings.
 - 4. Requests for Interpretation (RFIs).
- B. Related Sections include the following:
 - 1. Division 01 Section "Coordination Drawings" for preparing and submitting Contractors Coordination Drawings.
 - 2. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
 - 3. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 4. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
 2. Preparation of the Schedule of Values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Pre-installation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
 9. Project closeout activities.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 SUBMITTALS

- A. Coordination Drawings: Before construction work can begin, the respective Contractors shall submit to the Architect computer-drawn (CAD) coordination drawings in accordance with Division 01 Section "Coordination Drawings." Coordination drawings will be required throughout all areas for trades as indicated. Drawings to include, but not be limited to, resolutions of trade conflicts.
1. Coordination with Concurrent Work: Coordination Drawings shall be fully coordinated with and indicate scope of concurrent work awarded under separate construction contracts. Coordinate the Work of this Contract with work performed under these separate contracts accordingly.
 2. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, plumbing, electrical, telecom and fire protection systems.

- b. Indicate required installation sequences.
 - c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimensional changes and difficult installations will not be considered changes to the Contract.
 3. Refer to individual Sections for additional Coordination Drawing requirements for Work in those Sections.
 4. Number of Copies: Submit in accordance with General Conditions but not less than a minimum of three opaque copies of each submittal. Architect will return one copy.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
 1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Maintain current list at all times.

1.6 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
 1. Attendees: Authorized representatives of Owner and Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Critical work sequencing and long-lead items.
 - c. Designation of key personnel and their duties.
 - d. Procedures for processing field decisions and Change Orders.
 - e. Procedures for RFIs.
 - f. Procedures for testing and inspecting.

- g. Procedures for processing Applications for Payment.
 - h. Distribution of the Contract Documents.
 - i. Submittal procedures.
 - j. LEED requirements.
 - k. Preparation of Record Documents.
 - l. Use of the premises and existing building.
 - m. Work restrictions.
 - n. Owner's occupancy requirements.
 - o. Responsibility for temporary facilities and controls.
 - p. Construction waste management and recycling.
 - q. Parking availability.
 - r. Office, work, and storage areas.
 - s. Equipment deliveries and priorities.
 - t. First aid.
 - u. Security.
 - v. Progress cleaning.
 - w. Working hours.
3. Minutes: Record and distribute meeting minutes.
- C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. The Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at biweekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) RFIs.
 - 16) Status of proposal requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
 3. Minutes: Record the meeting minutes.
 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

- a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.7 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
 1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 1. Project name.
 2. Date.
 3. Name of Contractor.
 4. Name of Architect.
 5. RFI number, numbered sequentially.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 10. Contractor's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
 - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Hard-Copy RFIs:
 1. Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received after 2:00 p.m. will be considered as received the following working day.
 1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.

- b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to the "Montgomery Community College General Conditions"
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013118 – COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies minimum administrative and supervisory requirements necessary for coordination drawings on the Project to be collectively fulfilled by the Prime Contractors including, but not limited to:
 - 1) Coordination drawings.
- B. Each Contractor shall participate in these coordination requirements, even though certain areas of responsibility are assigned to a specific Contractor. General responsibility for overall coordination purposes will be with the Contractor assigned the responsibility or the General Contractor if no other assignment is made.
- C. All coordination drawings shall be updated to include any regulatory modifications required for the final trade permits.

1.3 COORDINATION

- A. Coordination: Contractor shall coordinate its construction activities with those of other Contractors, the Owner's on-site representative, and other entities involved to assure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with operations included under different Sections of the Specification that are dependent upon each other for proper installation, connection, and operation.
 - 1) Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, each Contractor shall schedule its construction activities in the sequence required to obtain the best results.
 - 2) Where availability of space is limited, each Contractor shall coordinate installation of different components with other Prime Contractors to assure maximum accessibility for required maintenance, service, and repair.
 - 3) Each Contractor shall make adequate provisions to accommodate items scheduled for later installation.
 - a. For all equipment designated as "Owner Furnished/Owner Installed" or "Owner Furnished/Contractor Installed", each contractor shall coordinate with owner provided equipment data sheets.
 - 4) No installation of permanent systems shall proceed until the coordination drawings have been reviewed by the Architect. When work is installed prior to the completion of the Architect's review, the Owner has the right to have the work

removed and reinstalled in sequence and in accordance with the reviewed coordination drawings at the defaulting contractor's expense.

- 5) When a Contractor goes beyond the specified coordination drawing duration or otherwise fails to fulfill its coordination drawing responsibilities the Owner also has the right but not the obligation to any Contractor to withhold the Contractor's Application for Payment(s) until the Contractor has fulfilled its coordination drawing responsibilities and forwarded the coordination drawings to the successor Contractor and/or Architect as applicable.
 - 6) When work has been installed without proper coordination, changes to this work deemed necessary by the Architect shall be made to correct the conditions without extra cost to the Owner.
 - 7) Device locations shall be coordinated to insure that conflicts will not exist once finishes and wall mounted items are installed.
- B. Conservation: Each Contractor shall coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
- 1) Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.4 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings between all Contractors to achieve the most efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

Upon execution of the Architect's "CADD User Agreement," electronic CAD files containing the "base" floor, roof and ceiling plans will be provided to each Contractor for their use in preparation of the Coordination Drawings.

- 1) Within 30 days of Notice to Proceed, the General Trades Contractor shall prepare and submit to the HVAC Contractor electronic CAD files and drawings of ¼-inch scale that indicate proposed structural elements and ceiling layouts in this Contract. These Coordination Drawings are to include the following items:
 - 2) Top and bottom of steel elevations.
 - 3) Additional structural elements.
 - 4) Reflected ceiling plans showing layout, type and height of ceilings.
 - a. Include ceiling mounted items including but not limited to bulkheads, cubicle curtain tracks, banners, LCD projector mounts, projection screens, television brackets, ceiling fans etc.
 - b. Note all elements that are not exposed above finished ceiling.

- 5) Refer to the Contract Documents for additional items, not listed, that require coordination.
- B. Within 10 days of receipt, the HVAC Contractor shall prepare and submit to the Plumbing Prime Contractor electronic CAD files and drawings of ¼-inch scale that indicate proposed routing of ductwork and piping in this Contract. These Coordination Drawings are to include the following items:
- 1) Ductwork, showing top and bottom of duct elevations.
 - 2) Piping, showing centerline of pipe. State outside diameter and insulation thickness.
 - 3) Equipment (including recessed equipment in walls, chases or above ceilings and housekeeping pads). Include minimum required access space for operation and maintenance.
 - 4) Floor, wall and roof penetrations.
 - 5) Fire and smoke dampers.
 - 6) Existing piping and equipment scheduled to remain (if applicable).
 - 7) Indicate size, elevation and general location of potential obstructions. Highlight and note any conflict points that might occur
 - 8) Show and dimension services required of other Contractors.
 - 9) Indicate required installation sequences.
 - 10) Show access door locations.
 - 11) Refer to the Contract Documents for additional items, not listed, that require coordination.
 - 12) Refer to Specification Section 230000, General HVAC Provisions for additional requirements.
- C. Within 10 days of receipt, the Plumbing Contractor shall prepare and submit to the Fire Protection Contractor electronic CAD files and drawings of ¼-inch scale that indicate proposed routing of ductwork and piping in this Contract. These Coordination Drawings are to include the following items:
- 1) Piping, showing centerline of pipe. State outside diameter and insulation thickness.
 - 2) Equipment (including recessed equipment in walls, chases or above ceilings and housekeeping pads). Include minimum required access space for operation and maintenance.
 - 3) Underground piping noting areas that penetrate footings and walls.
 - 4) Floor, wall and roof penetrations.

- 5) Floor drains and cleanout locations.
 - 6) Service entrances (including required access space for operation and maintenance).
 - 7) Existing piping and equipment (if applicable).
 - 8) Indicate size, elevation and general location of potential obstructions. Highlight and note any conflict points that might occur.
 - 9) Show and dimension services required of other Contractors.
 - 10) Indicate required installation sequences.
 - 11) Show access door locations.
 - 12) Refer to the Contract Documents for additional items, not listed, that require coordination.
- D. Refer to Division 21 Specifications for Fire Suppression Provisions and 220000, General Plumbing Provisions for additional requirements. Within 10 days of receipt, the Fire Protection Contractor shall prepare and submit to the Electrical Contractor electronic CAD files and drawings of ¼-inch scale that indicate proposed routing of ductwork and piping in this Contract. These Coordination Drawings are to include the following items:
- 1) Piping, showing centerline of pipe. State outside diameter and insulation thickness.
 - 2) Equipment (including recessed equipment in walls, chases or above ceilings and housekeeping pads). Include minimum required access space for operation and maintenance.
 - 3) Underground piping noting areas that penetrate footings and walls.
 - 4) Floor, wall and roof penetrations.
 - 5) Floor drains and cleanout locations.
 - 6) Valves, alarms and standpipe connections.
 - 7) Service entrances (including required access space for operation and maintenance).
 - 8) Existing piping and equipment (if applicable).
 - 9) Indicate size, elevation and general location of potential obstructions. Highlight and note any conflict points that might occur.
 - 10) Show and dimension services required of other Contractors.
 - 11) Indicate required installation sequences.
 - 12) Show access door locations.

- 13) Refer to the Contract Documents for additional items, not listed, that require coordination.
 - 14) Refer to Division 21 Specifications for Fire Suppression Provisions for additional requirements.
- E. Within 10 days of receipt, the Electrical Prime Contractor shall prepare and submit to the General Trades Prime Contractor electronic CAD files and drawings of ¼-inch scale that indicate proposed routing of ductwork and piping in this Contract. These Coordination Drawings are to include the following items:
- 1) Electrical conduit greater than 1-1/2-inches in diameter, both above and below grade.
 - 2) Electrical conduit groupings containing 10 or more conduits, both above and below grade.
 - 3) Locations of Electrical Power Distribution Equipment (including switchboards, distribution panelboards, branch circuit panelboards and transformers). Include minimum required access space for operation and maintenance.
 - 4) Emergency generator and associated distribution equipment
 - 5) Control Panels (including but not limited to Fire Alarm, Lighting Control, Dimming)
 - 6) Floor and roof penetrations.
 - 7) Housekeeping pads.
 - 8) Communications conduit greater than 1-1/2-inches in diameter, both above and below grade.
 - 9) Communications conduit groupings containing 10 or more conduits, both above and below grade.
 - 10) Cable trays.
 - 11) Telecommunications equipment racks.
 - 12) Control Panels (including but not limited to Security, Public Address, Telephone System and local sound reinforcement systems).
 - 13) Existing conduit ductbanks, distribution equipment and control panels that are to remain (if applicable).
 - 14) Indicate size, elevation and general location of potential obstructions. Highlight and note any conflict points that might occur.
 - 15) Show and dimension services required of other Contractors.
 - 16) Indicate required installation sequences.

- 17) Show access door locations.
 - 18) Refer to the Contract Documents for additional items, not listed, that require coordination.
 - 19) Refer to Specification Section 260000, General Electrical Provisions; 270000, General Communications Provisions and 280500 Common Work Results for Electronic Security for additional requirements.
- F. The Electrical Contractor shall submit the prepared Coordination Drawings to the General Trades Contractor who will call for a Coordination Meeting within five days of receipt of the drawings.
- G. The General Trades Contractor shall conduct Coordination Meeting.
- H. The General Trades Contractor shall submit 5 copies of the final Coordination Drawings to the Architect for review. Each set of Coordination Drawings shall bear the signature of an authorized representative from each Prime Contractor. Submit 3 CDs containing color PDFs and the CAD files of each of the drawings to the Architect.
- I. All Coordination Drawings shall be updated to include any regulatory modifications required for the final trade permits.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL COORDINATION DRAWING PROVISIONS

- A. Multiple drawings to convey the coordination effort shall be generated for the Architect to review. At a minimum, the following drawings shall be submitted per level / area.
- 1) Mechanical Duct Plan: All plan ductwork
 - 2) Mechanical Duct Riser Drawings: Each duct riser shall be shown in plan, E-W section, and N-S section.
 - 3) Mechanical Piping Plan: Plan with all mechanical piping.
 - 4) Plumbing Piping Plan: Plan with all plumbing piping.
 - 5) Mechanical Room Enlarged Plan: Plan showing all piping, equipment, access clearances and ductwork in the first floor mechanical room. The drawing shall include elevations and 3-D isometric drawings as required to convey the coordination of the mechanical room. The Scale of this drawing shall be 1/2" = 1'-0".
 - 6) AHU Service Corridor Enlarged Plan: Plan to show all ductwork, equipment, access clearances and piping in the AHU Service Corridor. This drawing shall show elevations and sections as required to convey the coordination of the AHU Service Corridor.
 - 7) Fire Protection Piping Plan: Plan with all fire protection piping.
 - 8) Fire Protection Stair Plan: Plan showing elevations of all fire protection piping and components in the stairwells.
 - 9) Electrical / Telecom Plan: Plan showing conduit and cable tray.
 - 10) Wall Device Drawing: Plan showing all wall mounted HVAC sensors, plumbing components, fire alarm devices and electrical devices in occupied spaces.
 - 11) Ceiling Coordination Drawing: Plan showing all elements in the ceiling or protruding through the ceiling including:
 - a. Grilles and Diffusers

- b. Lights
 - c. Sprinkler Heads
 - d. Occupancy Sensors (where applicable)
 - e. Fire Alarm Devices
 - f. Projectors
 - g. All Access Doors
- B. Coordination drawings shall be prepared on 30" x 42" sheet size, unless otherwise approved by the Architect. A key plan shall be used if the entire floor does not fit on one sheet.
- C. Upon execution of the Architects "CADD User Agreement" electronic CAD files containing the "base" floor, roof and ceiling plans will be provided to each Prime Contractor for their use in preparation of the Coordination Drawings.
- 1) A sample of the Architects "CADD User Agreement" is provided at the end of this section.
- D. The electronic CAD files shall be updated by each prime contractor and include the work of the previous trades. Each component (ie: general trades, mechanical, plumbing, electrical etc.) shall have its own unique layer/ level within the CAD file.
- E. Coordination Drawings shall be prepared in 3-D using a computer CAD program capable of producing / exporting files in a .dwg (AutoCAD) format.
- F. Each major component of the Coordination Drawings shall be visually represented with its own unique color in both electronic and printed forms.
- 1) General Trades items shall be shown in BLACK
 - a. Structural steel shall be shown in BLACK with 50% opacity (GRAY).
 - 2) HVAC ducts and all other non-piping items shall be shown in BLUE.
 - 3) HVAC piping items shall be shown in PURPLE.
 - 4) Plumbing items shall be shown in RED.
 - 5) Fire suppression items shall be shown in GREEN.
 - 6) Electrical items shall be shown in CYAN (Lt. Blue).
 - 7) Communications items shall be shown in MAGENTA (Fuschia).
- G. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

END OF SECTION 013118

Montgomery College - Rockville Campus
Science West Renovation and Addition

MHEC Project No. CC-01-414
MC Contract No. 533

CADD USER AGREEMENT BETWEEN

Montgomery College

HEREINAFTER CALLED "OWNER"

51 Mannakee Street

AND

Name Of Contractor

HEREINAFTER CALLED "CONTRACTOR"

Address 1

Address 2

DATED _____

WHEREAS, the Project Architect has prepared for this Montgomery College, computer-aided drawings for the construction of Science West, which do not constitute part of the Contract documents as described under the Contractor's Contract with the Owner.

WHEREAS, Contractor has been awarded a Enter Either a Subcontract or Contract to provide the Type of Construction construction to Name of Prime, the Discipline of Prime Contractor (hereinafter "Contractor");

WHEREAS, Contractor has requested that it be provided with the CADD Diskettes (hereinafter "Diskettes") which contain an electronic format of the following Drawings: Enter Drawing Numbers for Contractor to use in preparing its Shop Drawings on the above-described Project.

NOW, THEREFORE, to effect the arrangement to transfer electronic design data to Contractor, the Parties agree as follows:

1. That the electronic design data on diskettes is being provided to Contractor for the sole purpose stated above.
2. That the Project Architect's title block on each drawing contained with the design data must be deleted, and this Agreement grants no right to reproduce the title block.
3. Under no circumstances shall the providing of the Diskettes be deemed a sale of a product, and neither the Owner nor the Architect make any warranties, express or implied, in connection with the electronic design data or diskette.
4. Contractor understands that the automated conversion of information and data from the system and format used by the Architect to an alternate system or format cannot be accomplished without the introduction of inexactitudes, anomalies, and/or errors. Contractor also understands the inherent possibility of data loss from the use and storage of electronic data. Contractor also understands that this

agreement or the Contractor's use of the electronic design data does not relieve it of its other contractual responsibilities under the Construction Contract, that it remains fully responsible for its shop drawings and other submittals, and remains responsible to ensure that the electronic design data is in conformity with the design shown on the contract documents to the extent necessary to properly prepare its shop drawings. Contractor agrees to assume all risks associated with the use, conversion or storage of such electronic data.

5. Contractor also recognizes that changes or modifications to the Project Architect's instruments of professional service introduced by anyone other than the Architect may result in adverse consequences which cannot be predicted nor controlled and understood. Therefore, and in consideration of the Owner's agreement to deliver their instruments of professional service in machine readable form, Contractor agrees, to the fullest extent permitted by law, to hold harmless and indemnify the Owner and the Architect and their officers, employees, and consultants from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney's fees, arising out of or in any way connected with the conversion, modification, misinterpretation, misuse, or reuse by others of the machine readable information and data provided by the Architect under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation of this project.
6. A fee of \$Enter Fee per file or total fee of \$Enter Total Fee for the Enter Number of Drawings drawings is due upon receipt of the Diskettes.
7. The Contractor agrees to require its subcontractors who use any of the electronic design data to sign acceptance of the terms of this agreement, by agreement with the Contractor for the benefit of the Owner, Project Architect and their officers, employees, and consultants.
8. Use of any of the diskettes containing the described electronic design data constitutes acceptance of the terms of this agreement by the user as though the use were the Contractor described in this agreement.

This Agreement does not constitute an agreement with the Architect and create any cause of action of any kind of favor of the Contractor, its subcontractor, suppliers or any third party against the Architect or Owner. This CADD User Agreement is made for the benefit of the Owner and the Contractor and for the benefit of the Project Architect and its consultants.

CONTRACTOR:	OWNER:
By: _____	By: _____
Title: _____	Title: _____
Date: _____	Date: _____

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Preliminary Construction Schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Submittals Schedule.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Field condition reports.
 - 7. Special reports.
- B. Related Sections include the following:
 - 1. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
 - 2. Division 01 Section "Photographic Documentation" for submitting construction photographs.
 - 3. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
 - 4. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- G. Major Area: A story of construction, a separate building, or a similar significant construction element.
- H. Milestone: A key or critical point in time for reference or measurement.
- I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.4 SUBMITTALS

- A. Qualification Data: For scheduling consultant.
- B. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
 - 1. Scheduled date for first submittal.
 - 2. Specification Section number and title.
 - 3. Submittal category (action or informational).
 - 4. Name of subcontractor.
 - 5. Description of the Work covered.
 - 6. Scheduled date for Architect's final release or approval.
- C. Preliminary Construction Schedule: Submit two opaque copies.
- D. Preliminary Network Diagram: Submit two opaque copies, large enough to show entire network for entire construction period. Show logic ties for activities.
- E. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
 - 1. Submit an electronic copy of schedule, using software indicated, on CD-R, and labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.
- F. CPM Reports: Concurrent with CPM schedule, submit three copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number,

activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

G. Daily Construction Reports: Submit two copies at weekly intervals.

H. Material Location Reports: Submit two copies at monthly intervals.

I. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

J. Special Reports: Submit two copies at time of unusual event.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing, work stages, area separations, interim milestones and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review time required for review of submittals and resubmittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for completion and startup procedures.
9. Review and finalize list of construction activities to be included in schedule.
10. Review submittal requirements and procedures.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from parties involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
 - 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 - 2. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 21 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 - 4. Startup and Testing Time: Include not less than seven (7) days or as otherwise required by the Commissioning Agent, for startup and testing.

5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.

- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary of Work." Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary of Work." Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Startup and placement into final use and operation.
8. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Permanent space enclosure.
 - c. Completion of mechanical installation.
 - d. Completion of electrical installation.
 - e. Substantial Completion.

- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.
- G. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Preliminary Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.

- i. Testing and commissioning.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Principal events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the Schedule of Values).
- F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- G. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.

- b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.4 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions.
 - 7. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (refer to special reports).
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Meter readings and similar recordings.
 - 12. Emergency procedures.
 - 13. Orders and requests of authorities having jurisdiction.
 - 14. Change Orders received and implemented.
 - 15. Construction Change Directives received and implemented.
 - 16. Services connected and disconnected.
 - 17. Equipment or system tests and startups.
 - 18. Partial Completions and occupancies.
 - 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
 - 1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 - 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

- B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate Actual Completion percentage for each activity.

- C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final Completion construction photographs.
- B. Related Sections include the following:
 - 1. Division 01 Section "Submittal Procedures" for submitting photographic documentation.
 - 2. Division 01 Section "Closeout Procedures" for submitting digital media as Project Record Documents at Project closeout.
 - 3. Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
 - 4. Division 02 Section "Selective Structure Demolition" for photographic documentation before building demolition operations commence.

1.3 SUBMITTALS

- A. Qualification Data: For photographer.
- B. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same label information as corresponding set of photographs.
- C. Construction Photographs: Submit two sets of each photographic view within seven days of taking photographs.
 - 1. Format: Digital image electronically and on CD-ROM. CD-ROM to be maintained in field office in accordance with requirements of PART 3 EXECUTION of this specification section.
 - 2. Identification: Date and Time: Include date and time in filename for each image.
 - 3. Digital Images: Submit a complete set of digital image electronically as a Project Record Document on CD-ROM. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

1.4 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.5 COORDINATION

- A. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities, including temporary lighting required to produce clear, well-lit photographs without obscuring shadows.

1.6 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in uncompressed TIFF format, produced by a digital camera with minimum sensor size of 5.0 megapixels, and at an image resolution of not less than 1024 by 768 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified commercial photographer to take construction photographs. For other than Final Completion Construction Photographs, the photographs may be taken by the project manager, subject to review and approval of the College.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in filename for each image.
 - 2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect.
- D. Preconstruction Photographs: Before commencement of excavation, take digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.

1. Flag construction limits before taking construction photographs.
 2. Take eight photographs (minimum) to show existing conditions adjacent to property before starting the Work.
 3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- E. Periodic Construction Photographs: Take 12 digital photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Final Completion Construction Photographs: Take eight color photographs after date of Substantial Completion for submission as Project Record Documents. Architect will direct photographer for desired vantage points.
1. Do not include date stamp.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples and other submittals.
- B. Related Sections include the following:
 - 1. Contracting Requirements Section 000621 "Application and Certificate for Payment" for submitting Applications for Payment and the Schedule of Values.
 - 2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
 - 3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
 - 4. Division 01 Section "Photographic Documentation" for submitting construction photographs.
 - 5. Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
 - 6. Division 01 Section "Closeout Procedures" for submitting warranties.
 - 7. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 8. Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
 - 9. Divisions 02 through 49 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's and Construction Manager's responsive action.
- B. Informational Submittals: Written information that does not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow fourteen (14) calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow fourteen calendar (14) days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- D. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect and Construction Manager.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.

- E. Deviations: Encircle or otherwise specifically identify deviations from the Contract Documents on submittals.
 - F. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
 - 1. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Specification Section number and title.
 - i. Drawing number and detail references, as appropriate.
 - j. Transmittal number.
 - k. Submittal and transmittal distribution record.
 - l. Remarks.
 - m. Signature of transmitter.
 - 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
 - G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked "Approved" or "Approved as Noted".
 - H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
 - I. Use for Construction: Use only final submittals with mark indicating "Approved" or "Approved as Noted" by Architect.
- 1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES
- A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
 - 1. Electronic drawing files will be made available to the Contractor only if the Architect's CADD User Agreement is completed by the Contractor and signed by the Owner.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operation and maintenance manuals.
 - k. Compliance with specified referenced standards.
 - l. Testing by recognized testing agency.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
 - 4. Submit Product Data before or concurrent with Samples.
 - 5. Number of Copies: Submit four copies of Product Data, unless otherwise indicated. For product data that requires review by Architect's consultant, submit five copies. Architect will return two copies to contractor and will deliver one copy to owner.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.

- m. Relationship to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.
 - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
 - 3. Number of Copies: In addition to the number of copies Contractor requires for Contractor's use, submit three opaque copies of each submittal, unless copies are required for operation and maintenance manuals. Submit five copies where copies are required for operation and maintenance manuals. Architect will retain two copies; remainder will be returned.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
 - 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit three full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return one submittal with options selected to the contractor and will deliver one copy to the owner..
 - 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - 1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product.
 - 2. Number and name of room or space.
 - 3. Location within room or space.
 - 4. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
- F. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Contracting Requirements Section 000621 "Application and Certificate for Payment"
- H. Schedule of Values: Comply with requirements specified in Contracting Requirements Section 000621 "Application and Certificate for Payment"
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
 - 4. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
 - 5.
- J. LEED Submittals: Comply with requirements specified in Division 01 Section "Sustainable Design Requirements."
 - 1. Number of Copies: Submit three copies of LEED submittals, unless otherwise indicated.
- K. Material Safety Data Sheets (MSDSs) for LEED Certification: Submit information necessary to show compliance with LEED certification requirements, which will be the limit of the Architect's review.
 - 1. Architect will not review non-LEED submittals that include MSDSs and will return the entire submittal for resubmittal.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
 - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 1. Name of evaluation organization.
 2. Date of evaluation.
 3. Time period when report is in effect.
 4. Product and manufacturers' names.
 5. Description of product.
 6. Test procedures and results.
 7. Limitations of use.

- M. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerances.
 - 3. Sequence of installation or erection.
 - 4. Required installation tolerances.
 - 5. Required adjustments.
 - 6. Recommendations for cleaning and protection.
- T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products, and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.

- U. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- V. Construction Photographs: Comply with requirements specified in Division 01 Section "Photographic Documentation."
- W. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect except as required in "Action Submittals" Article
- X. Contractor's written response to Architect's Field Report findings.
- Y. Contractor's written response to Special Inspector's findings.

2.3 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S/ ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
1. Approved.
 2. Approved as Noted.
 3. Revise and Resubmit.
 4. Rejected.
 5. Not Required for Review.
- C. If Contractor's initial submittal is rejected for failure to comply with Contract Requirements and Contractor's resubmittal is rejected for failure to comply with Contract Requirements, the costs of additional reviews by Architect/Engineer made necessary by such failures shall be charged to the Contractor by Change Order.
- D. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- E. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate performance and aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
1. Indicate manufacturer and model number of individual components.
 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
 3. Refer to technical specifications for requirements for mockup specific submittals for elements of the exterior mockup.
 4. Provide a detailed schedule for the mock-up construction sequencing.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data : For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
 2. Entity responsible for performing tests and inspections.
 3. Description of test and inspection.
 4. Identification of applicable standards.
 5. Identification of test and inspection methods.
 6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspection.

- B. **Manufacturer's Technical Representative's Field Reports:** Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. **Factory-Authorized Service Representative's Reports:** Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. **Permits, Licenses, and Certificates:** For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

- A. **General:** Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. **Fabricator Qualifications:** A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. **Installer Qualifications:** A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Wall:
 - a. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - b. Notify Architect and Owner seven days in advance of dates and times when mockups will be constructed.
 - c. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 - d. Demonstrate the proposed range of aesthetic effects and workmanship.
 - e. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - 1) Allow seven days for initial review and each re-review of each mockup.
 - f. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - g. Demolish and remove mockups when directed unless otherwise indicated.

2. Roof:
 - a. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - b. Notify Architect and Owner seven days in advance of dates and times when mockups will be constructed.
 - c. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 - d. Demonstrate the proposed range of aesthetic effects and workmanship.
 - e. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - 1) Allow seven days for initial review and each re-review of each mockup.
 - f. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - g. Demolish and remove mockups when directed unless otherwise indicated.

- L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.
 1. Submit shop drawings and product data for materials included on mock-up with 30 days of Notice to Proceed. Submittals shall comply with appropriate sections of the Project Manual. These submittals shall be for the mock-up only, not the inclusion of these systems on the building. Submittals for inclusion of these systems on the building shall only be accepted after Approval of the mock-up.

2. Submit sequence of construction for integrated mock-up for owner and architect review. Owner and Architect will determine which stages of construction the mock-up will be reviewed for compliance with the contract documents.
3. Each sequence of the mock-up construction indicated in the approved schedule shall be reviewed and approved by the Architect and Owner prior to proceeding.
4. Mock-up shall be completed for review by the Architect and Owner within 90 days of Notice to Proceed package.
5. No materials or systems represented in the mock-up shall be installed in the Work prior to Approval of the mock-up.

M. Room Mockups: Construct room mockups incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work. Provide room mockups of the following rooms:

1. Typical Math Laboratory.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

- C. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. **Retesting/Reinspecting:** Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. **Testing Agency Responsibilities:** Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. **Associated Services:** Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
 1. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
- B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Commissioning Authority's reference during normal working hours.

3.2 TEST AND INSPECTION REPORTS

- A. Test and Inspection Reports: Prepare tests and inspections reports. Include the following:
1. Testing and Inspection reports must be submitted to the Owner and A/E no later than 48 hours after the inspection or testing.
 2. "Testing and Inspection Reports" must be titled as such. Use of language "Field Report" or "Observation Report" or similar, is not acceptable.
 3. The Report shall indicate the elements and areas that were inspected and list any items found to be not in compliance with the Contract Documents and approved shop drawings, and the reason for non-compliance. The report shall contain the statement: "The following structural elements were inspected and found to be in compliance with the Contract Documents and approved shop drawings with the following exceptions:....." Use of language "observed", "appeared to be in compliance", "general compliance" or similar, is not acceptable.
 4. Any Report containing any non-compliance items must be clearly marked so on the front page and on the transmittal or e-mail. The A/E will not review and scrutinize every single Inspection Report to uncover noncompliance items.
- B. Non-Compliance List:
1. The Testing and Inspection agency must maintain a list of all noncompliance items found, the date of inspection, the resolution, and the date item was resolved.
 2. The list must be distributed to the A/E at least bi-weekly.

3.3 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AAADM	American Association of Automatic Door Manufacturers www.aaadm.com	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists (The) www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	ACI International (American Concrete Institute) www.aci-int.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700

AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHA	American Hardboard Association (Now part of CPA)	
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America (Now PLANET)	
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(405) 780-7372
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems (See APA)	
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute	(703) 524-8800

	www.ari.org	
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
AWCI	AWCI International (Association of the Wall and Ceiling Industry International) www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (Now WCSC)	
AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636
AWPA	American Wood-Preservers' Association www.awpa.com	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association)	(616) 285-3963

	International) www.bifma.com	
CCC	Carpet Cushion Council www.carpetcushion.org	(610) 527-3880
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CPA	Composite Panel Association www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	(800) 510-2772 (202) 462-9607
CRI	Carpet & Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSA	Canadian Standards Association	(800) 463-6727 (416) 747-4000
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Cast Stone Institute www.caststone.org	(717) 272-3744
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)	(281) 583-4087

	www.cti.org	
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee www.ejdc.org	(703) 295-5000
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association www.esda.org	(315) 339-6937
FM Approvals	FM Approvals www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG) www.fmglobal.com	(401) 275-3000
FMRC	Factory Mutual Research (Now FM Global)	
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GRI	(Now GSI)	
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	

HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
IAS	International Approval Services (Now CSA International)	
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
ISO	International Organization for Standardization www.iso.org	41 22 749 01 11
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (702) 567-8150
ITS	Intertek Testing Service NA www.intertek.com	(972) 238-5591
LMA	Laminating Materials Association (Now part of CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	

MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-3550
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (303) 697-8441
NFPA	National Fire Protection Association www.nfpa.org	(800) 344-3555 (617) 770-3000

NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association) www.nofma.com	(901) 526-5016
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	National Sanitation Foundation International www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736 (540) 751-0930
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)	
NWWDA	National Wood Window and Door Association (Now WDMA)	
OPL	Omega Point Laboratories, Inc. (Now ITS)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting & Decorating Contractors of America www.pdca.com	(800) 332-7322 (314) 514-7322
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PGI	PVC Geomembrane Institute http://pgi-tp.ce.uiuc.edu	(217) 333-3929
PLANET	Professional Landcare Network (Formerly: ALCA - Associated Landscape Contractors of America) www.landcarenetwork.org	(800) 395-2522 (703) 736-9666
PTI	Post-Tensioning Institute	(602) 870-7540

	www.post-tensioning.org	
RCSC	Research Council on Structural Connections www.boltcouncil.org	
RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(516) 294-5424
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(703) 683-2075
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)	
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings	(877) 281-7772

	www.sspc.org	(412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TCA	Tile Council of America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 649-5555
TRI	Tile Roofing Institute www.tilerroofing.org	(312) 670-4177
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USGBC	U.S. Green Building Council www.usgbc.org	(202) 828-7422
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCMA	Window Covering Manufacturers Association (Now WCSC)	
WCSC	Window Covering Safety Council (Formerly: WCMA) www.windowcoverings.org	(800) 506-4636 (212) 297-2109
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of	(916) 372-9943

California)
www.wicnet.org

WIC	Woodwork Institute of California (Now WI)	
WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

BOCA	BOCA International, Inc. (See ICC)	
IBC	International Building Code (See ICC)	
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICBO	International Conference of Building Officials (See ICC)	
ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)	
ICC	International Code Council www.iccsafe.org	(888) 422-7233 (703) 931-4533
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
SBCCI	Southern Building Code Congress International, Inc. (See ICC)	
UBC	Uniform Building Code (See ICC)	

- C. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA), Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities www.access-board.gov	(800) 872-2253 (202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections include the following:
 - 1. Division 01 Section "Summary of Work" for limitations on utility interruptions and other work restrictions.
 - 2. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 3. Division 01 Section "Execution" for progress cleaning requirements.
 - 4. Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
 - 5. Division 31 Section "Termite Control" for pest control.
 - 6. Division 32 Section "Concrete Paving" for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Water Service: Pay water service use charges for water used by all entities for construction operations.
- C. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.5 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.6 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

1.8 CODE COMPLIANCE

- A. All work shall comply with Chapter 33 – Safeguards During Construction of the International Building Code.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pavement: Comply with Division 32 paving Sections.
- B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 9-gage, galvanized steel, chain-link fabric fencing; minimum 8 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete bases for supporting posts.
- C. Lumber and Plywood: Comply with requirements in Division 06 Section "Rough Carpentry."
- D. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- F. Paint: Comply with requirements in Division 09 painting Sections.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including desk and chair for the exclusive use of the Architect, file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack board.
 - 3. Drinking water and private toilet.
 - 4. Coffee machine and supplies.
 - 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 - 6. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
 - 1. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
- E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- F. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service [overhead] [underground], unless otherwise indicated.
 - 2. Connect temporary service to Owner's existing power source, as directed by Owner.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Install lighting for Project identification sign.
- J. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Engineers' offices.
 - f. Owner's office.
 - g. Principal subcontractors' field and home offices.
 2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- K. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.
1. Provide DSL in primary field office.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide off-site parking areas for construction personnel. No parking is permitted on campus.

- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- F. Project Identification and Temporary Signs: Provide Project identification and other signs. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
 - 1. Provide temporary, directional signs for construction personnel and visitors.
 - 2. Maintain and touchup signs so they are legible at all times.
- G. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- J. Temporary Elevator Use: Refer to Division 14 Sections for temporary use of new elevators.
- K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- L. Existing Stair Usage: Use of Owner's existing stairs will be permitted, as long as stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If, despite such protection, stairs become damaged, restore damaged areas so no evidence remains of correction work.
- M. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Division 01 Section "Summary of Work."

- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - 1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Tree and Plant Protection: Comply with requirements specified in Division 32 Section " Tree Protection and Trimming"
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.
- G. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Covered Walkway: Erect structurally adequate, protective, covered walkway for passage of individuals along adjacent public street(s). Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.
 - 1. Construct covered walkways using scaffold or shoring framing.
 - 2. Provide wood-plank overhead decking, protective plywood enclosure walls, handrails, barricades, warning signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
 - 3. Extend back wall beyond the structure to complete enclosure fence.
 - 4. Paint and maintain in a manner approved by Owner and Architect.
- J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures and install a barrier to prevent the migration of air through the temporary enclosure.
- K. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
- L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Prohibit smoking or the use of tobacco products in all areas. Montgomery College is a tobacco-free campus.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.
- M. Temporary Ventilation: Maintain negative air in the construction zone.
1. Provide negative machines that are hepa-filtered with the exhaust relief discharge at a location that is acceptable to the Owner.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Termination and Removal: Remove each temporary facility when needed, or its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street

- paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Sections:
 - 1. Division 01 Section "Temporary Facilities and Controls" for temporary site fencing.

1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape at 6 inches (150 mm) above the ground for trees up to, and including, 4-inch (100-mm) size; and 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
 - 1. Species and size of tree.
 - 2. Location on site plan. Include unique identifier for each.
 - 3. Reason for pruning.
 - 4. Description of pruning to be performed.
 - 5. Description of maintenance following pruning.

- C. Qualification Data: For qualified arborist and tree service firm.
- D. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- E. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- F. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
 - 1. Use sufficiently detailed photographs or videotape.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.5 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA or Licensed arborist in jurisdiction where Project is located.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
 - b. Enforcing requirements for protection zones.
 - c. Arborist's responsibilities.
 - d. Field quality control.

1.6 PROJECT CONDITIONS

- A. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) in diameter; and free of weeds, roots, and toxic and other nonsoil materials.
 - 1. Obtain topsoil only from well-drained sites where topsoil is 4 inches (100 mm) deep or more; do not obtain from bogs or marshes.
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
 - 1. Type: Shredded hardwood or Ground or shredded bark.
 - 2. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements.
 - 1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and weighing a minimum of 0.4 lb/ft. (0.6 kg/m); remaining flexible from minus 60 to plus 200 deg F (minus 16 to plus 93 deg C); inert to most chemicals and acids; minimum tensile yield strength of 2000 psi (13.8 MPa) and ultimate tensile strength of 2680 psi (18.5 MPa); secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet (2.4 m) apart.
 - a. Height: 4 feet (1.2 m).
 - b. Color: High-visibility orange, nonfading.
 - 2. Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches (914 mm).
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
 - 1. Size and Text: As shown on Drawings.
 - 2. Lettering: 3-inch- (75-mm-) high minimum, black characters on white background.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Tie a 1-inch (25-mm) blue-vinyl tape around each tree trunk at 54 inches (1372 mm) above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.
 - 1. Apply 6-inch (150-mm) average thickness of organic mulch. Do not place mulch within 6 inches (150 mm) of tree trunks.

3.3 TREE- AND PLANT-PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
 - 1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
 - 2. Access Gates: Install where indicated; adjust to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 20 feet (6 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.

- D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
- E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
 - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
 - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

- A. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.
- B. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.
- C. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

- A. Prune roots that are affected by temporary and permanent construction. Prune roots as shown on Drawings and as follows:
 - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 - 2. Cut Ends: Coat cut ends of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to arborist.
 - 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 - 4. Cover exposed roots with burlap and water regularly.
 - 5. Backfill as soon as possible according to requirements in Division 31 Section "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune roots 12 inches (300 mm) inside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.

- C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as shown on Drawings and as follows:
 - 1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
 - 2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
 - a. Type of Pruning: Cleaning.
 - 3. Cut branches with sharp pruning instruments; do not break or chop.
 - 4. Do not apply pruning paint to wounds.
- B. Chip removed branches and spread over areas identified by Arborist.

3.7 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
 - 1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
- C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Minor Fill within Protection Zone: Where existing grade is 2 inches (50 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
1. Submit details of proposed root cutting and tree and shrub repairs.
 2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
 3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
 4. Perform repairs within 24 hours.
 5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Trees: Remove and replace trees indicated to remain that are more than 66 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
1. Provide new trees of same size and species as those being replaced for each tree that measures 6 inches (150 mm) or smaller in caliper size.
 2. Provide one new tree of 6-inch (150-mm) caliper size for each tree being replaced that measures more than 6 inches (150 mm) in caliper size.
 - a. Species: Species selected by Arborist with Owner's approval.
 3. Plant and maintain new trees as specified in Division 32 Section "Plants."
- C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) o.c. Backfill holes with an equal mix of augered soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 015639

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Division 01 Section "References" for applicable industry standards for products specified.
 - 2. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
 - 3. Divisions 02 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed as specified, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service

performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
 3. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 4. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.
- B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Use form acceptable to Owner and Architect.
 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.

- f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Acceptance: Change Order.
 - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
 - C. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
 - b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.
 - D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.
- 1.5 QUALITY ASSURANCE
- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Store cementitious products and materials on elevated platforms.
 5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 7. Protect stored products from damage and liquids from freezing.
 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
 - 3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 3. Where products are accompanied by the term "as selected," Architect will make selection.
 - 4. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 - 6. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
 - 1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
 - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
 - 3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 - 4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 - 5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
 - 6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.

7. **Basis-of-Design Product:** Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
8. **Visual Matching Specification:** Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
9. **Visual Selection Specification:** Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
 - a. **Standard Range:** Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. **Full Range:** Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

- A. Refer to Montgomery Community College General Conditions.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

- B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 01 Section "Submittal Procedures" for submitting surveys.
3. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
4. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- D. Certified Surveys: Submit two copies signed by professional engineer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.

- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 7 feet in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Division 02 Section "Selective Structure Demolition" for demolition of selected portions of the building.
 - 2. Divisions 02 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - 3. Division 07 Section "Penetration Firestopping" for patching fire-rated construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
 1. Foundation construction.
 2. Bearing and retaining walls.
 3. Structural concrete.
 4. Structural Steel.
 5. Structural decking.
 6. Lintels.
 7. Miscellaneous structural metals.
 8. Equipment supports.
 9. Piping, ductwork, vessels, and equipment.
 10. Roofing and support systems.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete, Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for environmental-protection measures during construction.
 - 2. Division 04 Section "Unit Masonry" for disposal requirements for masonry waste.
 - 3. Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE GOALS

- A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of 75 percent by weight of total waste generated by the Work.
1. Demolition Waste:
 - a. Asphaltic concrete paving.
 - b. Concrete.
 - c. Concrete reinforcing steel.
 - d. Brick.
 - e. Concrete masonry units.
 - f. Structural and miscellaneous steel.
 - g. Piping.
 - h. Supports and hangers.
 - i. Valves.
 - j. Sprinklers.
 - k. Mechanical equipment.
 - l. Refrigerants.
 - m. Electrical conduit.
 - n. Copper wiring.
 - o. Lighting fixtures.
 - p. Ballasts.
 - q. Electrical devices.
 - r. Switchgear and panelboards.
 - s. Transformers.
 2. Construction Waste:
 - a. Site-clearing waste.
 - b. Masonry and CMU.
 - c. Lumber.
 - d. Wood sheet materials.
 - e. Metals.
 - f. Roofing.
 - g. Insulation.
 - h. Piping.
 - i. Electrical conduit.
 - j. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Plastic pails.

1.5 SUBMITTALS

- A. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- B. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

- C. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- E. Waste Management Plan: Submit 3 copies of plan within 7 days of date established for the Notice of Award.
- F. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit three copies of report. Include separate reports for demolition and construction waste. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- G. Waste Reduction Calculations: Before request for Substantial Completion, submit three copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- H. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt..
- I. LEED Submittal: LEED letter template for Credit MR 2.1 and 2.2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.
- J. Qualification Data: For Waste Management Coordinator and refrigerant recovery technician.

1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.

3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until installation.
 4. Protect items from damage during transport and storage.
 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Owner's Use:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area on-site or location as designated by Owner.
 5. Protect items from damage during transport and storage.

3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 2. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.3 RECYCLING DEMOLITION WASTE

- A. Asphaltic Concrete Paving: Grind asphalt to maximum 1-1/2-inch size.
 1. Crush asphaltic concrete paving and screen to comply with requirements in Division 31 Section "Earth Moving" for use as general fill.
- B. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.

- C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum 1-1/2-inch size.
 - 2. Crush concrete and screen to comply with requirements in Division 31 Section "Earth Moving" for use as satisfactory soil for fill or subbase.
- D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Pulverize masonry to maximum 1-1/2-inch size.
 - a. Crush masonry and screen to comply with requirements in Division 31 Section "Earth Moving" for use as satisfactory soil for fill or subbase.
 - b. Crush masonry and screen to comply with requirements in Division 32 Section "Trees, Shrubs and Ground Covers" for use as mineral mulch.
 - 2. Clean and stack undamaged, whole masonry units on wood pallets.
- E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- F. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- G. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- H. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- I. Lighting Fixtures: Separate lamps by type and protect from breakage.
- J. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.
- K. Conduit: Reduce conduit to straight lengths and store by type and size.

3.4 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Site-Clearing Wastes: Chip brush, branches, and trees on-site.
 - 1. Comply with requirements in Division 32 Section "Trees, Shrubs and Ground Covers" for use of chipped organic waste as organic mulch.
- C. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.

2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Comply with requirements in Division 32 Section "Trees, Shrubs and Ground Covers" for use of clean sawdust as organic mulch.

3.5 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

- 1. Inspection procedures.
- 2. Warranties.
- 3. Final cleaning.

- B. Related Sections include the following:

- 1. Contracting Requirements Section 000621 "Application and Certificate for Payment" for submitting Applications for Payment and the Schedule of Values.
- 2. Division 01 Section "Photographic Documentation" for submitting Final Completion construction photographs and negatives.
- 3. Division 01 Section "Execution" for progress cleaning of Project site.
- 4. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- 5. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
- 6. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

- 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
- 2. Advise Owner of pending insurance changeover requirements.
- 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
- 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
- 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.

1.6 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to unusual operating conditions.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

- p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Maintenance manuals for the care and maintenance of products, materials, and finishes systems and equipment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
 - 3. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

- A. Initial Submittal: Submit 3 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion (2 for Architect / 1 for Commissioning Agent). Include a complete operation and maintenance directory. Architect will return one copy of draft and mark whether general scope and content of manual are acceptable.
- B. Final Submittal: Submit two printed and two electronic copies on cd of each manual in final form at least 15 days before final inspection (1 each for Architect / 1 each for Commissioning Agent). Architect will return copy with comments within 15 days after final inspection.

1. Correct or modify each manual to comply with Architect's comments. Submit 3 printed copies of each corrected manual and two electronic copies on cd within 15 days of receipt of Architect's comments.

1.5 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
 1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.

3. Name and address of Owner.
 4. Date of submittal.
 5. Name, address, and telephone number of Contractor.
 6. Name and address of Architect.
 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.

3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

- C. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Normal shutdown instructions.
 - 7. Seasonal and weekend operating instructions.
 - 8. Required sequences for electric or electronic systems.
 - 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard printed maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."
- G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training videotapes.
- B. Related Sections include the following:
 - 1. Division 01 Section "Project Management and Coordination" for requirements for preinstruction conferences.
 - 2. Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections.
- C. Allowances: Furnish demonstration and training instruction time under the Demonstration and Training Allowance as specified in Division 01 Section "Allowances."
- D. Unit Price for Instruction Time: Length of instruction time will be measured by actual time spent performing demonstration and training in required location. No payment will be made for time spent assembling educational materials, setting up, or cleaning up.

1.3 SUBMITTALS

- A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. At completion of training, submit one complete training manual(s) for Owner's use.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

- E. Demonstration and Training Videotapes: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date videotape was recorded.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - 2. Transcript: Prepared on 8-1/2-by-11-inch (215-by-280-mm) paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Photographer Qualifications: A professional photographer who is experienced photographing construction projects.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
 - 1. Motorized doors, including overhead coiling doors and automatic entrance doors.
 - 2. Equipment, including projection screens.
 - 3. Fire-protection systems, including fire alarm and fire-extinguishing systems.
 - 4. Intrusion detection systems.
 - 5. Conveying systems, including elevators.
 - 6. Heat generation, including boilers, pumps and water distribution piping.
 - 7. Refrigeration systems, including chillers, cooling towers, condensers, pumps and distribution piping.
 - 8. HVAC systems, including air-handling equipment, air distribution systems and terminal equipment and devices.
 - 9. HVAC instrumentation and controls.
 - 10. Electrical service and distribution, including transformers, switchboards, panelboards uninterruptible power supplies and motor controls.
 - 11. Packaged engine generators, including transfer switches.
 - 12. Lighting equipment and controls.
 - 13. Communication systems, including intercommunication, surveillance, voice and data and television equipment.

- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.

 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project Record Documents.
 - e. Identification systems.

- f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.

- c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
- d. Instructions for identifying parts and components.
- e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 017900

CERTIFICATION OF EQUIPMENT DEMONSTRATION

DATE: _____

PROJECT: _____

CONTRACT: _____

IN ACCORDANCE WITH THE CONTRACT DOCUMENTS, A DEMONSTRATION IN THE OPERATION OF THE BELOW LISTED ITEMS OF EQUIPMENT WAS CONDUCTED TO THE SATISFACTION OF ALL PARTIES IN ATTENDANCE.

AUTHORIZED OWNER REPRESENTATIVES

ITEMS DEMONSTRATED

DEMONSTRATOR

SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes general requirements and procedures for compliance with certain U.S. Green Building Council's (USGBC) LEED prerequisites and credits needed for the Project to obtain LEED Gold certification.
 - 1. Other LEED prerequisites and credits needed to obtain LEED certification are dependent on material selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests.
 - 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification are dependent on the Architect's design and other aspects of the Project that are not part of the Work of the Contract.
- B. Related Sections include the following:
 - 1. Divisions 01 through 49 Sections for LEED requirements specific to the Work of each of those Sections. These requirements may or may not include reference to LEED.

1.3 DEFINITIONS

- A. Certificates of Chain-of-Custody: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria." Certificates shall include evidence that mill is certified for chain-of-custody by an FSC-accredited certification body.
- B. LEED: Leadership in Energy & Environmental Design.
- C. Rapidly Renewable Materials: Materials made from agricultural products that are typically harvested within a ten-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.
- D. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles (800 km) from the Project location. Manufacturing refers to the final assembly of components into the building product that is installed at the Project site.
- E. Regionally Extracted, Harvested, or Recovered Materials: Materials that are extracted, harvested, or recovered and manufactured within a radius of 500 miles (800 km) from the Project site.

- F. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer).
 - 1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
 - 2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.

1.4 SUBMITTALS

- A. General: Submit additional LEED submittal requirements included in other sections of the Specifications.
- B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
- C. Project Materials Cost Data: Provide statement indicating total cost for building materials used for Project. Include statement indicating total cost of mechanical and electrical components.
- D. LEED Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to Proceed indicating how the following requirements will be met.
 - 1. Credit MR 2.1 and 2.2: Waste management plan complying with Division 01 Section "Construction Waste Management and Disposal."
 - 2. Credit MR 4.1 and 4.2: List of proposed materials with recycled content.
 - a. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
 - 3. Credit MR 5.1 and 5.2: List of proposed regionally manufactured materials and regionally extracted, harvested, or recovered materials.
 - a. Identify each regionally manufactured material, its source, and cost.
 - b. Identify each regionally extracted, harvested or recovered material, its source, and cost.
 - 4. Credit MR 7.0: List of proposed certified wood products.
 - a. Indicate each product containing certified wood, its source, and cost.
 - b. Include statement indicating total cost for wood-based materials used for Project, including non-rented temporary construction.
 - 5. Credit EQ 3.1: Construction indoor air quality management plan.
- E. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:

1. Credit MR 2.1 and 2.2: Waste reduction progress reports complying with Division 01 Section "Construction Waste Management and Disposal."
2. Credit MR 4.1 and 4.2: Recycled content.
3. Credit MR 5.1 and 5.2: Regionally manufactured materials and regionally extracted, harvested, or recovered materials.

F. LEED Documentation Submittals:

1. Credit SS 7.2: Product Data for roofing materials .
2. Credit SS 8.0: Product Data for interior and exterior lighting fixtures that stop direct-beam illumination from leaving the building site.
3. Credit WE 3.1: Product Data for plumbing fixtures indicating water consumption.
4. Prerequisite EA 3.0: Product Data for new HVAC equipment indicating absence of CFC refrigerants.
5. Credit EA 4.0: Product Data for new HVAC equipment indicating absence of HCFC refrigerants.
6. Credit EA 5.0: Product Data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy and water consumption performance over time.
7. Credit MR 2.1 and 2.2: Comply with Division 01 Section "Construction Waste Management and Disposal."
8. Credit MR 4.1 and 4.2: Product Data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
9. Credit MR 5.1 and 5.2: Product Data indicating location of material manufacturer for regionally manufactured materials.
 - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
 - b. Include statement indicating cost and distance from point of extraction, harvest, or recovery to Project for each raw material used in regionally manufactured materials.
10. Credit MR 7.0: Product Data and certificates of chain-of-custody for products containing certified wood.
 - a. Include statement indicating costs for each product containing certified wood.
 - b. Include statement indicating total cost for wood-based materials used for Project, including non-rented temporary construction.
11. Credit EQ 1.0: Product Data and Shop Drawings for carbon dioxide monitoring system.
12. Credit EQ 3.1:
 - a. Construction indoor air quality management plan.
 - b. Product Data for temporary filtration media.
 - c. Product Data for filtration media used during occupancy.
 - d. Construction Documentation: Six photographs at three different occasions during construction along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.
13. Credit EQ 3.2:

- a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
 - b. Product Data for filtration media used during flush-out and during occupancy.
 - c. Report from testing and inspecting agency indicating results of IAQ testing and documentation showing conformance with IAQ testing procedures and requirements.
14. Credit EQ 4.1: Product Data for adhesives and sealants used on the interior of the building indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA method 24).
 15. Credit EQ 4.2: Product Data for paints and coatings used on the interior of the building indicating chemical composition and VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA method 24).
 16. Credit EQ 4.3: Product Data for carpet products indicating VOC content of each product used.
 17. Credit EQ 4.4: Product Data for composite wood and agrifiber products indicating that products contain no urea-formaldehyde resin.
 - a. Include statement indicating adhesives and binders used for each product.
 18. Credit EQ 6.2: Product Data and Shop Drawings for sensors and control system used to provide individual airflow and temperature controls for minimum 50 percent of non-perimeter, regularly occupied space.
 19. Credit EQ 7: Product Data and Shop Drawings for sensors and control system used to monitor and control room temperature and humidity.

PART 2 - PRODUCTS

2.1 RECYCLED CONTENT OF MATERIALS

- A. Credits MR 4.1 and MR 4.2: Provide building materials with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 10 percent of the cost of materials used for the Project.
 1. The cost of post-consumer recycled content of an item shall be determined by dividing the weight of post-consumer recycled content in the item by the total weight of the item and multiplying by the cost of the item.
 2. The cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing the weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by the total weight of the item and multiplying by the cost of the item.
 3. Do not include mechanical and electrical components in the calculation.
 4. Recycled content of materials shall be defined according to the Federal Trade Commission's "Guide for the Use of Environmental Marketing Claims," 16 CFR 260.7 (e).

2.2 REGIONAL MATERIALS

- A. Credit MR 5.1: Provide 20 percent of building materials (by cost) that are regionally manufactured materials.

- B. Credit MR 5.2: Of the regionally manufactured materials required by Paragraph "Credit MR 5.1" above, provide at least 50 percent (by cost) that are regionally extracted, harvested, or recovered materials.

2.3 CERTIFIED WOOD

- A. Credit MR 7.0: Provide a minimum of 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria."
1. Wood-based materials include but are not limited to the following materials when made from made wood, engineered wood products, or wood-based panel products:
 - a. Rough carpentry.
 - b. Miscellaneous carpentry.
 - c. Finish carpentry.
 - d. Architectural woodwork.
 - e. Wood paneling.
 - f. Wood veneer wall covering.
 - g. Wood cabinets.
 - h. Non-vented temporary construction, including bracing, concrete formwork, pedestrian barriers, and temporary protection.

2.4 LOW-EMITTING MATERIALS

- A. Credit EQ 4.1: For interior applications use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24):
1. Wood Glues: 30 g/L.
 2. Metal to Metal Adhesives: 30 g/L.
 3. Adhesives for Porous Materials (Except Wood): 50 g/L.
 4. Subfloor Adhesives: 50 g/L.
 5. Plastic Foam Adhesives: 50 g/L.
 6. Carpet Adhesives: 50 g/L.
 7. Carpet Pad Adhesives: 50 g/L.
 8. VCT and Asphalt Tile Adhesives: 50 g/L.
 9. Cove Base Adhesives: 50 g/L.
 10. Gypsum Board and Panel Adhesives: 50 g/L.
 11. Rubber Floor Adhesives: 60 g/L.
 12. Ceramic Tile Adhesives: 65 g/L.
 13. Multipurpose Construction Adhesives: 70 g/L.
 14. Fiberglass Adhesives: 80 g/L.
 15. Structural Glazing Adhesives: 100 g/L.
 16. Wood Flooring Adhesive: 100 g/L.
 17. Contact Adhesive: 250 g/L.
 18. Plastic Cement Welding Compounds: 350 g/L.
 19. ABS Welding Compounds: 400 g/L.
 20. CPVC Welding Compounds: 490 g/L.
 21. PVC Welding Compounds: 510 g/L.
 22. Adhesive Primer for Plastic: 650 g/L.
 23. Sealants: 250 g/L.

24. Sealant Primers for Nonporous Substrates: 250 g/L.
 25. Sealant Primers for Porous Substrates: 775 g/L.
- B. Credit EQ 4.2: For interior applications use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24) and the following chemical restrictions:
1. Flat Paints and Coatings: VOC not more than 50 g/L.
 2. Non-Flat Paints and Coatings: VOC not more than 150 g/L.
 3. Anti-Corrosive Coatings: VOC not more than 250 g/L.
 4. Varnishes and Sanding Sealers: VOC not more than 350 g/L.
 5. Stains: VOC not more than 250 g/L.
 6. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 7. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1, 2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.
 - o. Hexavalent chromium.
 - p. Isophorone.
 - q. Lead.
 - r. Mercury.
 - s. Methyl ethyl ketone.
 - t. Methyl isobutyl ketone.
 - u. Methylene chloride.
 - v. Naphthalene.
 - w. Toluene (methylbenzene).
 - x. 1, 1, 1-trichloroethane.
 - y. Vinyl chloride.
- C. Credit EQ 4.4: Do not use composite wood and agrifiber products that contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 SITE DISTURBANCE

- A. Credit SS 5.1: Comply with requirements of Division 01 Section "Summary of Work."

3.2 REFRIGERANT REMOVAL

- A. Prerequisite EA 3.0: Remove CFC-based refrigerants from existing HVAC and refrigeration equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in Division 22 Sections.
- B. Credit EA 4.0: Remove HCFC-based refrigerants from existing HVAC and refrigeration equipment indicated to remain and replace with refrigerants that are not HCFC based. Replace or adjust equipment to accommodate new refrigerant.

3.3 CONSTRUCTION WASTE MANAGEMENT

- A. Credit MR 2.1 and 2.2: Comply with Division 01 Section "Construction Waste Management and Disposal."

3.4 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT

- A. Credit EQ 3.1: Comply with SMACNA IAQ Guideline for Occupied Buildings under Construction.
 - 1. If Owner authorizes the use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 - 2. Replace all air filters immediately prior to occupancy. Replacement air filters shall have a MERV 13 according to ASHRAE 52.2.
- B. Credit EQ 3.2:
 - 1. Conduct a two-week building air flush-out after construction ends with new air filters and 100 percent outdoor air. Replace air filters after building air flush-out. Replacement air filters shall have a MERV 13 according to ASHRAE 52.2.
 - 2. Engage an independent testing and inspecting agency to conduct a baseline indoor air quality testing program according to EPA Protocol for Environmental Requirements, Baseline IAQ and Materials, for Research Triangle Park Campus, Section 01445.

END OF SECTION 018113



LEED-NC

LEED-NC Version 2.2 Registered Project Checklist

Montgomery College Science West Renovation and Addition
Rockville, Maryland

Yes ? No

9	1	4	Sustainable Sites	14 Points
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Y					
Y				Prereq 1 Construction Activity Pollution Prevention	Required
1				Credit 1 Site Selection	1
1				Credit 2 Development Density & Community Connectivity	1
			1	Credit 3 Brownfield Redevelopment	1
1				Credit 4.1 Alternative Transportation , Public Transportation Access	1
1				Credit 4.2 Alternative Transportation , Bicycle Storage & Changing Rooms	1
			1	Credit 4.3 Alternative Transportation , Low-Emitting and Fuel-Efficient Vehicles	1
1				Credit 4.4 Alternative Transportation , Parking Capacity	1
			1	Credit 5.1 Site Development , Protect or Restore Habitat	1
	1			Credit 5.2 Site Development , Maximize Open Space	1
1				Credit 6.1 Stormwater Design , Quantity Control	1
1				Credit 6.2 Stormwater Design , Quality Control	1
1				Credit 7.1 Heat Island Effect , Non-Roof	1
1				Credit 7.2 Heat Island Effect , Roof	1
			1	Credit 8 Light Pollution Reduction	1

Yes ? No

4	1		Water Efficiency	5 Points
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1				Credit 1.1 Water Efficient Landscaping , Reduce by 50%	1
1				Credit 1.2 Water Efficient Landscaping , No Potable Use or No Irrigation	1
			1	Credit 2 Innovative Wastewater Technologies	1
1				Credit 3.1 Water Use Reduction , 20% Reduction	1
1				Credit 3.2 Water Use Reduction , 30% Reduction	1

Yes ? No

10	6	1	Energy & Atmosphere	17 Points
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Y					
Y				Prereq 1 Fundamental Commissioning of the Building Energy Systems	Required
Y				Prereq 2 Minimum Energy Performance	Required
Y				Prereq 3 Fundamental Refrigerant Management	Required
6	4			Credit 1 Optimize Energy Performance	1 to 10
1	2			Credit 2 On-Site Renewable Energy	1 to 3
1				Credit 3 Enhanced Commissioning	1
1				Credit 4 Enhanced Refrigerant Management	1
			1	Credit 5 Measurement & Verification	1
1				Credit 6 Green Power	1

continued...

Yes ? No

4 3 6 Materials & Resources 13 Points

Y				Prereq 1	Storage & Collection of Recyclables	Required
			1	Credit 1.1	Building Reuse , Maintain 75% of Existing Walls, Floors & Roof	1
			1	Credit 1.2	Building Reuse , Maintain 100% of Existing Walls, Floors & Roof	1
			1	Credit 1.3	Building Reuse , Maintain 50% of Interior Non-Structural Elements	1
1				Credit 2.1	Construction Waste Management , Divert 50% from Disposal	1
1				Credit 2.2	Construction Waste Management , Divert 75% from Disposal	1
			1	Credit 3.1	Materials Reuse , 5%	1
			1	Credit 3.2	Materials Reuse , 10%	1
1				Credit 4.1	Recycled Content , 10% (post-consumer + ½ pre-consumer)	1
	1			Credit 4.2	Recycled Content , 20% (post-consumer + ½ pre-consumer)	1
1				Credit 5.1	Regional Materials , 10% Extracted, Processed & Manufactured Regional	1
	1			Credit 5.2	Regional Materials , 20% Extracted, Processed & Manufactured Regional	1
			1	Credit 6	Rapidly Renewable Materials	1
	1			Credit 7	Certified Wood	1

Yes ? No

9 3 3 Indoor Environmental Quality 15 Points

Y				Prereq 1	Minimum IAQ Performance	Required
Y				Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
	1			Credit 1	Outdoor Air Delivery Monitoring	1
	1			Credit 2	Increased Ventilation	1
1				Credit 3.1	Construction IAQ Management Plan , During Construction	1
1				Credit 3.2	Construction IAQ Management Plan , Before Occupancy	1
1				Credit 4.1	Low-Emitting Materials , Adhesives & Sealants	1
1				Credit 4.2	Low-Emitting Materials , Paints & Coatings	1
1				Credit 4.3	Low-Emitting Materials , Carpet Systems	1
1				Credit 4.4	Low-Emitting Materials , Composite Wood & Agrifiber Products	1
1				Credit 5	Indoor Chemical & Pollutant Source Control	1
1				Credit 6.1	Controllability of Systems , Lighting	1
	1			Credit 6.2	Controllability of Systems , Thermal Comfort	1
1				Credit 7.1	Thermal Comfort , Design	1
			1	Credit 7.2	Thermal Comfort , Verification	1
			1	Credit 8.1	Daylight & Views , Daylight 75% of Spaces	1
			1	Credit 8.2	Daylight & Views , Views for 90% of Spaces	1

Yes ? No

3 2 Innovation & Design Process 5 Points

1				Credit 1.1	Innovation in Design : Public Education	1
	1			Credit 1.2	Innovation in Design : MR7 Exemplary Performance (95% or greater)	1
1				Credit 1.3	Innovation in Design : WE3 Exemplary Performance (Exceed 30%)	1
	1			Credit 1.4	Innovation in Design : MR2.2 Exemplary Performance (95% or greater)	1
1				Credit 2	LEED® Accredited Professional	1

Yes ? No

39 15 15 Project Totals (pre-certification estimates) 69 Points

Certified 26-32 points Silver 33-38 points Gold 39-51 points Platinum 52-69 points

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Related Sections:
 - 1. Division 01 Sections or General Conditions- Project Management and Coordination: Specifies coordination and administrative requirements. Introduce commissioning and refer to Cx documents.
 - 2. Division 01 Sections or General Conditions- Submittals and Submittal Procedures: Stipulates copies of submittals to be submitted and refers to other sections for additional submittal requirements related to Cx.
 - 3. Division 01 Sections or General Conditions- Closeout Procedures: As applicable, defines milestones in completion which must also include the Cx process defined herein.
 - 4. Division 01 Sections or General Conditions- Operation, Maintenance, and Product Data: As applicable, refers to documentation and procedures relative to the O&M information.
 - 5. Division 01 Sections or General Conditions- Demonstration and Training: As applicable, refers to documentation and procedures relative to Training.
 - 6. Division 01 Sections or General Conditions- Construction Indoor Air Quality Management: Specifies certain precautions and procedures for maintaining IAQ throughout construction.
 - 7. Division 07 Section "Thermal and Moisture Protection" Testing.
 - 8. Division 23 Section "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.
 - 9. Division 23 Section "Commissioning of Integrated Automation" for commissioning process activities for integrated automation systems, assemblies, equipment, and components.
 - 10. Division 23 Section "TAB Commissioning" for commissioning process activities for Testing, Adjusting and Balancing.
 - 11. Division 26 Section "Commissioning of Electrical Systems" for commissioning process activities for electrical systems, assemblies, equipment, and components.
 - 12. The Commissioning Plan- The Cx Plan shall be available for reference as it outlines responsibilities outside of the Construction Contract. It gives the Contractor a perspective as to the overall process. It encompasses the entire Cx process throughout all phases of the project including design through post construction.

1.3 SCOPE

- A. The following systems will be commissioned for this project:

1. Structural Systems: Commissioning testing and inspection of the structural systems will be by the Independent testing and inspection agency. Quality control reports from the testing and inspection agency will be collected and organized in a binder for the CxA to be part of the Total Building Commissioning final report.
2. Roofing System: The Roofing Commissioning services will be in accordance with Division 17 Testing Requirements for the Commissioning Process.
3. Exterior Envelope Systems: The Exterior Envelope Commissioning services will be in accordance with Division 8 Testing Requirements for the Commissioning Process.
4. Elevator Systems: The elevator installer's acceptance will be performed in accordance with Division 14 and with ASME A17.1, and field testing quality control forms will be provided to the CxA by the contractor to be included as part of the Total Building Commissioning final report.
5. Plumbing Systems: Commissioning in accordance with section 220800.
6. HVAC Systems: Commissioning in accordance with sections 230600, 230800, and 230999.
7. Electrical Systems: Commissioning in accordance with section 260800.
8. Telecommunication/AV/Security Systems: Commissioning for telecommunications systems will be performed by the contractor per the Field Quality Control testing procedures outlined in Division 27. Final system test reports from the contractor, approved by Montgomery College IT group, will be collected and organized in a binder by the CxA to become part of the Total Building Commissioning final report.
9. Fire Protection Systems: Commissioning and testing of the fire suppression system and the fire alarm systems will be by the contractor in accordance with NFPA, the local Authority Having Jurisdiction and the testing requirements in the applicable Division 21 and Division 28. Final system acceptance reports from the contractor, approved by the AHJ, will be collected and organized in a binder by the CxA to become part of the Total Building Commissioning final report.

1.4 DEFINITIONS

- A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA: Commissioning Authority.
- D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.5 COMMISSIONING TEAM

- A. Members Appointed by Contractor: Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process

through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.6 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.7 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 3. Attend commissioning team meetings held on a biweekly basis.
 4. Integrate and coordinate commissioning process activities with construction schedule.
 5. Review and comment on Project-specific construction checklists and commissioning process test procedures.
 6. Complete paper construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
 7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
 8. Coordinate commissioning process test procedures.

1.8 CxA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan.
- C. Convene commissioning team meetings.
- D. Provide Project-specific construction checklists and commissioning process test procedures.

- E. Review and accept completed construction checklists provided by the contractor.
- F. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
- G. Prepare and maintain the Issues Log.
- H. Prepare and maintain completed construction checklist log.
- I. Witness selected systems, assemblies, equipment, and component startup.
- J. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

1.9 OWNER'S and A/E's RESPONSIBILITIES

- A. The owner's and A/E's responsibilities will be as indicated in the commissioning plan developed by the CxA.

1.10 SPECIALIZED TESTING BY CONTRACTOR

- A. Where specialized testing is specified in the technical specifications, Contractor, subcontractor, vendor, or factory representative as applicable shall conduct the specified testing and provide all specialized instrumentation and equipment. CxA and other CxT members may witness tests at their discretion. CxT may in some cases independently spot check the results of the tests if the tests were not witnessed. However it is not the intent for the CxT to reaccomplish testing that is specified in the construction specifications. All specialized testing procedures shall be integrated with the Cx process and all documentation shall be coordinated and integrated with the documentation of the Cx process. Examples of specialized testing include but are not limited to:

1. Generator load testing (not building power outage functional testing which will be administered by CxA).
2. Acceptance testing of the Fire Alarm System.
3. Disinfection and Sterilization of Domestic Water System.
4. Piping Systems Hydrostatic Testing.
5. Hydronic System Water Treatment Testing.
6. Ductwork Leakage Testing.
7. Fire Suppression system and Fire Pump hydraulic tests.
8. Testing and Demonstration of Lighting Controls.
9. Electrical System Testing per NETA.

1.11 BUILDING POWER OUTAGE TEST

- A. Aspects of other functional tests will be done in concert with this test. Coordinate this test after all systems are ready for power outage test.
- B. Simulate all potential combinations of power outages reasonably possible.

1. Simulate prolonged outage, at least 2 hours by opening main feeders.
 2. Simulate momentary outage by opening and closing main breakers as quickly as possible.
- C. While normal power is disconnected, survey the facility for safe conditions and system operation as applicable.
- D. Simulate all return to normal.

1.12 INDOOR ENVIRONMENT TESTING/MONITORING

- A. Sample 25%, max failure limit 10%.
- B. Spot check and monitor key environmental parameters for various spaces including:
1. Indoor Temperatures and Humidities.
 2. Air Quality:
 - a. CO₂ levels
 - b. VOC levels
 - c. Airborne particulate
 3. In-zone parameter deviations
 4. Pressurization
 5. Noise level
 6. Air Movement
 7. Light Levels
- C. Where applicable, check all monitors, emergency switches, containment provisions, etc.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 019113

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

- B. Related Sections include the following:

1. Division 01 Section "Summary of Work" for use of premises, and phasing, and Owner-occupancy requirements.
2. Division 01 Section "Photographic Documentation" for preconstruction photographs taken before selective demolition operations.
3. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
4. Division 01 Section "Cutting and Patching" for cutting and patching procedures.
5. Division 01 Section "Construction Waste Management and Disposal" for disposal of demolished materials.
6. Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.5 SUBMITTALS

- A. Qualification Data: For demolition firm and professional engineer.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Locations of proposed dust- and noise-control temporary partitions and means of egress.
 - 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 - 7. Means of protection for items to remain and items in path of waste removal from building.
- C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- D. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 Section "Photographic Documentation." Submit before Work begins.
- E. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
 - 1. Comply with submittal requirements in Division 01 Section "Construction Waste Management and Disposal."

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- C. LEED Requirements for Building Reuse:
 - 1. Credit MR 1.1: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

2. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
 3. Credit MR 1.2: Maintain existing nonshell, nonstructural components (walls, flooring, and ceilings) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
- D. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- E. Standards: Comply with ANSI A10.6 and NFPA 241.
- F. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 5. Review areas where existing construction is to remain and requires protection.

1.7 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
1. Comply with requirements specified in Division 01 Section "Summary of Work."
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner under a separate contract before start of the Work.
 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, and preconstruction photographs.
 1. Comply with requirements specified in Division 01 Section "Photographic Documentation."
- G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
 1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary of Work."
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal."
- B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.
1. Building Structure and Shell: 75 percent.
 2. Nonshell Elements: 50 percent.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
 - 1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- F. Roofing: Remove no more existing roofing than can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Refer to Division 07 Sections for new roofing requirements.
 - 1. Remove existing roof membrane, flashings, copings, and roof accessories.
 - 2. Remove existing roofing system down to substrate.
- G. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Suspended slabs.
 - 5. Slabs on steel deck.
 - 6. Building frame members.
 - 7. Composite steel frame members.
 - 8. Building walls.
 - 9. Retaining walls.

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

- E. Welding certificates.
- F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- G. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Fiber reinforcement.
 - 6. Waterstops.
 - 7. Curing compounds.
 - 8. Floor and slab treatments.
 - 9. Bonding agents.
 - 10. Adhesives.
 - 11. Vapor retarders.
 - 12. Semirigid joint filler.
 - 13. Joint-filler strips.
 - 14. Repair materials.
- H. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- I. Minutes of pre-installation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - a) Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- D. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete,"
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - 2. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Void Forms: High Density Extruded Polystyrene with minimum compressive strength of 40 psi (275 KPa) and minimum compressive modulus of 1,400 psi (9,650 KPa).
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

- H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed, where welding is required.
- C. Plain-Steel Wire: ASTM A 82, galvanized.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II gray.
Supplement with the following:
 - a. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

- C. Lightweight Aggregate: ASTM C 330, 3/4-inch (19-mm) nominal maximum aggregate size.
- D. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.7 FIBER REINFORCEMENT

- A. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, [1-1/2 to 2-1/2 inches long].
 - 1. Available Products:
 - a. Fibrillated Fibers:
 - i. Euclid Chemical Company; Fiberstrand F.
 - ii. Grace Construction Products, W. R. Grace & Co.; Grace Fibers.
 - iii. SI Concrete Systems; Fibermesh.

2.8 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).
 - 1. Available Products:
 - a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
 - b. Concrete Sealants Inc.; Conseal CS-231.
 - c. Greenstreak; Swellstop.

2.9 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class A, not less than 15 mils (0.38 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
1. Available Products:
 - a. Fortifiber Corporation; Moistop Ultra 15.
 - b. Raven Industries Inc.; VaporBlock VB15.
 - c. Stego Industries, LLC; Stego Wrap, Class A, 15 mils.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

2.10 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 8 (2.36-mm) sieve.
1. Available Products:
 - a. Anti-Hydro International, Inc.; Emery.
 - b. Dayton Superior Corporation; Emery Non-Slip.
 - c. Emeri-Crete, Inc.; Emeri-Topcrete.
 - d. L&M Construction Chemicals, Inc.; Grip It.
 - e. Metalcrete Industries; Metco Anti-Skid Aggregate.

2.11 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Available Products:
 - a. Dayton Superior Corporation; Sure Film.
 - b. Euclid Chemical Company (The); Eucobar.
 - c. Sika Corporation, Inc.; SikaFilm.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Available Products:
 - a. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
 - b. Euclid Chemical Company (The); Kurez DR VOX.
 - c. L&M Construction Chemicals, Inc.; L&M Cure R.
 - d. Meadows, W. R., Inc.; 1100 Clear.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, non-dissipating.
1. Available Products:
 - a. Dayton Superior Corporation; Safe Cure and Seal (J-18).
 - b. Euclid Chemical Company (The); Aqua Cure VOX.
 - c. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - d. Meadows, W. R., Inc.; Vocomp-20.

2.12 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
- E. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4000 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 4000 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.14 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Ground Granulated Blast-Furnace Slag: 50 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings, Foundation Walls, Slabs-on-Grade : Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches (100 mm) or 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
 4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
 5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
- B. Suspended Slabs: Proportion structural lightweight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 2. Calculated Equilibrium Unit Weight: 110 lb/cu. ft. (1762 kg/cu. m), plus or minus 3 lb/cu. ft. (48.1 kg/cu. m) as determined by ASTM C 567.
 3. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).
 4. Air Content: 6 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size greater than 3/8 inch (10 mm).
 5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
- C. Concrete Toppings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 2. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
 3. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
 4. Air Content: Do not allow air content of troweled finished toppings to exceed 3 percent.
 5. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd. (0.90 kg/cu. m).
- D. Building Frame Members: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45
 3. Slump Limit: 4 inches (100 mm) or 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
 4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.

2.16 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.17 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
 2. Concrete that did not meet the above criteria of time shall be rejected. Any elements cast with such concrete shall be removed regardless of any strength results of samples, cores, etc.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
 2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms

and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks, but no later than 1 hour after completion of finishing operations.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.7 WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of

bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in 1 direction.
 - 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated to receive trowel finish.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces indicated, exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m)] of dampened slip-resistive aggregate over surface in 1 or 2 applications. Tamp aggregate flush with surface, but do not force below surface.
 2. After broadcasting and tamping, apply float finish.
 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq.

ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method

recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspection Reports:
 - 1. Testing and Inspection reports must be submitted to the Owner and A/E no later than 48 hours after the inspection or testing.
 - 2. "Testing and Inspection Reports" must be titled as such. Use of language "Field Report" or "Observation Report" or similar, is not acceptable.
 - 3. The Report shall indicate the elements and areas that were inspected and list any items found to be not in compliance with the Contract Documents and approved shop drawings, and the reason for non-compliance. The report shall contain the statement: "The following structural elements were inspected and found to be in compliance with the Contract Documents and approved shop drawings with the following exceptions:....." Use of language "observed", "appeared to be in compliance", "general compliance" or similar, is not acceptable.
 - 4. Any Report containing any non-compliance items must be clearly marked so on the front page and on the transmittal or e-mail. The A/E will not review and scrutinize every single Inspection Report to uncover non-compliance items.
- C. Non-Compliance List:
 - 1. The Testing and Inspection agency must maintain a list of all non-compliance items found, the date of inspection, the resolution, and the date item was resolved.
 - 2. The list must be distributed to the A/E at least bi-weekly.
- D. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Headed bolts and studs.
 - 4. Verification of use of required design mixture.
 - 5. Concrete placement, including conveying and depositing.
 - 6. Curing procedures and maintenance of curing temperature.
 - 7. Verification of concrete strength before removal of shores and forms from beams and slabs.

- E. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. A set of standard cylinders / specimens is defined as follows:
 - i. Two for 6-inch diameter x 12-inch long cylinders.
 - ii. Three for 4-inch diameter x 8-inch long cylinders.
 - b. Cast and laboratory cure two sets of standard cylinder specimens for each composite sample.
 - c. Cast and field cure two sets of standard cylinder specimens for each composite sample.

Field cured cylinders must be made, cured, and protected in a manner that is representative of and simulates the in-place concrete for the representing elements being cast. Curing field-cured cylinders in an insulated box on site is not acceptable.
 - d. The contractor may request casting and testing additional sets of cylinders for testing at other concrete age, at his discretion, use, and cost.
 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of laboratory-cured specimens at 7 days and one set at 28 days.
 - b. Test one set of field-cured specimens at 7 days and one set at 28 days.

- c. A compressive-strength test shall be the average compressive strength from a set of specimens obtained from same composite sample and tested at age indicated.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
 9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 10. Nondestructive Testing: Windsor Probes, Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect to establish areas of low strength, but will not be used as a basis approval of concrete.
 11. Additional Tests: Testing and inspecting agency shall make additional sets of specimens and other tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, and as directed by the Architect.
 12. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 13. Any additional testing, inspections, and engineering to evaluate compliance of questionable concrete with project requirements shall be at Contractor's expense.
 14. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, curing methods and procedures or other requirements have not been met or followed, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 15. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 16. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

END OF SECTION 033000

SECTION 033301 - ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes for the following items:
 - 1 Interior cast-in-place concrete benches.
 - 2 Exposed concrete columns.
- B. Related Sections include the following:
 - 1 Division 03 Section "Cast-In-Place Concrete" for formwork; material, fabrication, and installation requirements for steel reinforcement; and field quality control.
 - 2 Division 07 Section "Interior Joint Sealants" for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.

1.3 DEFINITIONS

- A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.
- D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

E. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.

F. Samples: For each of the following materials:

- 1 Form-facing panel.
- 2 Form ties.
- 3 Form liners.
- 4 Coarse- and fine-aggregate gradations.
- 5 Chamfers and rustications.

G. Samples for Verification: Architectural concrete Samples, cast vertically, approximately 18 by 18 by 2 inches (450 by 450 by 50 mm), of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

H. Qualification Data: For manufacturer.

I. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates.

J. Material Certificates: For each of the following, signed by manufacturer:

- 1 Cementitious materials.
- 2 Admixtures.
- 3 Form materials and form-release agents.
- 4 Repair materials.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

- 1 Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician,

- Grade 1, according to ACI CP-01 or an equivalent certification program.
- 2 Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- C. Source Limitations for Cast-in-Place Architectural Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from one manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."
- E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- F. Mockups: Before casting architectural concrete, build mockups to verify selections made under sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
- 1 Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2 Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
 - 3 In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
 - 4 Obtain Architect's approval of mockups before casting architectural concrete.
 - 5 Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Form-Facing Panels for As-Cast Finishes: Steel, glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that will provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will provide surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch (19 by 19 mm), minimum; nonstaining; in longest practicable lengths.
- E. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch (6 mm) thick.

- F. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or S, Grade NS, that adheres to form joint substrates.
- G. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.
- H. Form-Release Agent: Commercially formulated colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, glass-fiber-reinforced plastic ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish glass-fiber-reinforced plastic ties, not less than 1/2 inch (13 mm) in diameter, of color selected by Architect from manufacturer's full range.

2.2 STEEL REINFORCEMENT AND ACCESSORIES

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I white. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - c. Silica Fume: ASTM C 1240, amorphous silica.
 - 2. Blended Hydraulic Cement: ASTM C 595.
- B. Normal-Weight Aggregates: ASTM C 33, Class 1N coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse Aggregate Size: 3/8 inch (10 mm).
 - 2. Gradation: Uniformly graded.
- C. Normal-Weight Fine Aggregate: ASTM C 33 or ASTM C 144, manufactured or natural sand, from same source for entire Project.
- D. Water: Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.

- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 - 1. Color: As selected by Architect from manufacturer's full range.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

2.6 REPAIR MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.
- B. Proportion concrete mixtures as follows:
 - 1 Compressive Strength (28 Days): 3500 psi (24.1 MPa).
 - 2 Maximum Water-Cementitious Materials Ratio: 0.46.
 - 3 Slump Limit: 3 inches (75 mm), plus or minus 1 inch (25 mm).
 - 4 Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size.

- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXING

- A. Ready-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
 - 1 Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
 - 2 When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for formwork, embedded items, and shoring and reshoring.
- B. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch (3.2 mm).
- C. Fabricate forms to result in cast-in-place architectural concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like for easy removal.
 - 1 Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
 - 2 Do not use rust-stained steel form-facing material.
- E. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- F. Do not chamfer exterior corners and edges of cast-in-place architectural concrete unless indicated otherwise.
- G. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.

- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 REINFORCEMENT AND INSERTS

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.
- B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.3 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1 Schedule form removal to maintain surface appearance that matches approved mockups.
 - 2 Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.
- B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated or otherwise damaged form-facing material. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4 JOINTS

- A. Construction Joints: Install construction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1 Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
 - 2 Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

- 3 Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

- B. Contraction Joints: Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.
 4. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 5. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 6. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 7. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
 8. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.
 9. E. Hot-Weather Placement: Comply with ACI 301 and as follows:
 10. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 11. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.6 FINISHES, GENERAL

- A. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed

surfaces.

1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

B. Maintain uniformity of special finishes over construction joints, unless otherwise indicated.

3.7 AS-CAST FORMED FINISHES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects.

3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.

B. Begin curing cast-in-place architectural concrete immediately after removing forms from concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:

1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural concrete continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.
3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 FIELD QUALITY CONTROL

A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for field quality-control requirements.

3.10 REPAIRS, PROTECTION, AND CLEANING

A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.

1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.
- B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.
- D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- E. Wash and rinse surfaces according to concrete finish applicator's written recommendations. Protect other Work from staining or damage due to cleaning operations.
 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

END OF SECTION 033301

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Concrete masonry units.
2. Face brick.
3. Structural-clay facing tile.
4. Mortar and grout.
5. Steel reinforcing bars.
6. Masonry joint reinforcement.
7. Ties and anchors.
8. Embedded flashing.
9. Miscellaneous masonry accessories.
10. Masonry-cell insulation.

- B. Related Sections:

1. Division 05 Section "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
2. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Contractor will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
1. Clay Masonry Unit Test: For each type of unit required, according to ASTM C 67 for compressive strength.
 2. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
 3. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 4. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
 5. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.
 6. Prism Test: For each type of construction required, according to ASTM C 1314.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
- C. Samples for Initial Selection:
1. Face brick.
 2. Weep holes/vents.
- D. Samples for Verification: For each type and color of the following:
1. Exposed CMUs.
 2. Face brick.
 3. Special brick shapes.
 4. Structural clay facing tile
 5. Weep holes and vents.
 6. Accessories embedded in masonry.

1.7 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such

deviations are specifically brought to the attention of Architect and approved in writing.

- B. Qualification Data: For testing agency.
 - C. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include data on material properties.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence according to ASTM C 67.
 - d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Reinforcing bars.
 - 6. Joint reinforcement.
 - 7. Anchors, ties, and metal accessories.
 - D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
 - E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
 - F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.
- 1.8 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
 - B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
 - C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - a. Include a sealant-filled joint at least 16 inches long in each exterior wall mockup.
 - b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
 - c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
 - d. Include metal studs, sheathing, sheathing joint-and-penetration treatment air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
 - 2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
 - 3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
 - 4. Protect accepted mockups from the elements with weather-resistant membrane.
 - 5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 2. Density Classification: Normal weight.

2.3 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: Facing brick complying with ASTM C 216.
1. Products: Basis of design Subject to compliance with requirements :
 - a. Belden Brick, 470-479 Dark to match existing brick provided at adjacent Montgomery College Science Center and Science East buildings in color and texture.
 2. Grade: SW.
 3. Type: FBX.
 4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 4400 psi.
 5. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
 6. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 7. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
 8. Application: Use where brick is exposed unless otherwise indicated.
 9. Color and Texture: Match existing brick provided at adjacent Montgomery College Science Center and Science East buildings.

2.4 STRUCTURAL-CLAY FACING TILE

A. General:

1. Provide solid, multicored, or hollow units, with shape and direction of cores optional unless otherwise indicated.
2. Where reinforced masonry is indicated, provide multicored units designed for use in reinforced, grouted masonry; either with vertical cores and with webs notched to receive horizontal reinforcement, or with horizontal cores and with holes in bed shells for placement of grout and to receive vertical reinforcement.
3. Where indicated for exterior applications, provide units recommended by manufacturer for exterior use in Project's location.
4. Provide special shapes where required for corners, jambs, coved bases, sills, and other special conditions indicated, including applications that cannot be produced by sawing standard units.

B. Glazed Structural-Clay Facing Tile: ASTM C 126, Grade S (select).

1. Products: Basis of Design Subject to compliance with requirements, provide the following:
 - a. Elgin/Butler Company 4W Series, Glazed Front.
 - b. Sizes: Actual face dimensions of 7-5/8 x 7-5/8 x 1-3/4 inches.
 - c. Provide special units glazed on ends and tops, as well as faces for corners, jambs, sills, pilasters, columns, and other applications indicated, where glazed units are exposed on other surfaces and faces.
 - d. Colors: Dove Gray to match existing glazed structural-clay facing tile used at adjacent Science East and Science Center buildings.
 - e. Patterns: Stacked coursing
 - f. Compressive strength: 7000 psi.

2.5 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Davis Colors; True Tone Mortar Colors.
 - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.

- c. Solomon Colors, Inc.; SGS Mortar Colors.

 - F. Colored Cement Product: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Colored Portland Cement-Lime Mix:
 - 1) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - 2) Lafarge North America Inc.; Eaglebond Portland & Lime.
 - 3) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
 - 2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 - 3. Pigments shall not exceed 10 percent of portland cement by weight.

 - G. Aggregate for Mortar: ASTM C 144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

 - H. Aggregate for Grout: ASTM C 404.

 - I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Euclid Chemical Company (The); Accelguard 80.
 - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
 - c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

 - J. Water: Potable.
- 2.6 REINFORCEMENT
- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

 - B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
 - 1. Exterior Walls: Stainless steel.
 - 2. Wire Size for Side Rods: 0.148-inch diameter.
 - 3. Wire Size for Cross Rods: 0.148-inch diameter.

4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
5. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Multiwythe Masonry:

1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

2.7 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
3. Stainless-Steel Sheet: ASTM A 666, Type 304.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

1. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Hohmann & Barnard, Inc. Blok-Lok BL-407

b. Fabricate sheet metal anchor sections and other sheet metal parts from 0.078-inch- thick, stainless-steel sheet.

c. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.25-inch- diameter, stainless-steel wire.

2. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads.

a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Dayton Superior Corporation, Dur-O-Wal Division; Stainless Steel SX Fastener.
- 2) ITW Buildex; Scots long life Teks.

2.8 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Division 07 Section "Sheet Metal Flashing and Trim" and as follows:
1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
 2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
 - a. The flashing sheets should overlap a minimum of 4". Embed splice plate with sealant before applying it to the joint or provide flexible flashing for splice plate.
 3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
 4. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 5. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.
- B. Application: Unless otherwise indicated, use the following:
1. Where flashing is indicated to receive counterflashing, use metal flashing.
 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
 4. Where flashing is fully concealed, use metal flashing.
- C. Solder and Sealants for Sheet Metal Flashings: As specified in Division 07 Section "Sheet Metal Flashing and Trim."
- D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- C. Weep/Vent Products: Use one of the following unless otherwise indicated:
1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

- a. Products: Subject to compliance with requirements, provide the following:
 - 1) Hohmann & Barnard, Inc.; Quadro-Vent.
- D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Hohmann & Barnard, Inc., The Mortar Net.
 - 2. Provide one of the following configurations:
 - a. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.
 - b. Sheets or strips full depth of cavity and installed to full height of cavity.

2.10 MASONRY-CELL INSULATION

- A. Loose-Granular Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime mortar unless otherwise indicated.
 - 3. For exterior masonry, use portland cement-lime mortar.
 - 4. For reinforced masonry, use portland cement-lime mortar.
 - 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type S.
 - 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 4. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments

with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Mix to match color of mortar at conditions for each unit at adjacent Science East and Science Center buildings.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Face brick.
 - b. Glazed structural-clay facing tile.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a

continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

1. No field cutting of lip brick is allowed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
1. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from 3/8 inch thickness by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.

2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Fill space between pipes, conduit, boxes, ties, and other items that penetrate masonry, solidly with mortar unless otherwise indicated.
- H. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- I. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- J. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 1. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Lay structural-clay tile as follows:
1. Lay vertical-cell units with full head joints unless otherwise indicated. Provide bed joints with full mortar coverage on face shells and webs.
 2. Lay horizontal-cell units with full bed joints unless otherwise indicated. Keep drainage channels, if any, free of mortar. Form head joints with sufficient mortar so excess will be squeezed out as units are placed in position. Butter both sides of units to be placed, or butter one side of unit already in place and one side of unit to be placed.
 3. Maintain joint thicknesses indicated except for minor variations required to maintain bond alignment. If not indicated, lay walls with 1/4- to 3/8-inch- thick joints.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.
- E. Cut joints flush for masonry walls to receive plaster, waterproofing, air barriers, or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
1. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
 2. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not over 8 inches clear horizontally and 16 inches clear vertically.
 3. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

- B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
- C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- D. Apply air barrier to face of backup wythe to comply with Division 07 Section "Fluid-Applied Membrane Air Barriers" and "Self-Adhering Sheet Waterproofing."
- E. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 - 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.7 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 - 2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
 - 3. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
 - 4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 - 5. Space anchors at metal stud construction as indicated, but not more than 18

- inches o.c. vertically and 24 inches o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
6. Space anchors at multi wythe masonry construction as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.
 7. Patch and repair all penetrations made in self-adhered sheet waterproofing and / or fluid-applied membrane air barriers as required to provide complete and continuous membrane at all anchors as recommended by membrane / barrier manufacturer and according to the requirements of the applicable specification section (071326 and 072726.)

3.9 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 1. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- C. Form expansion joints in brick as follows:
 1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."
- D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.
 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS

- A. Install steel lintels as required at masonry openings and where indicated.

3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as

- recommended by flashing manufacturer.
 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe.
 3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use specified weep/vent products to form weep holes.
 2. Space weep holes 24 inches o.c. unless otherwise indicated.
- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.12 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Contractor will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
1. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.

- C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- D. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.14 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.15 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Excess Masonry Waste: Remove excess clean masonry waste and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 0420

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel.
 - 2. Architecturally exposed structural steel.
 - 3. Grout.
- B. Related Sections include the following:
 - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 05 Section "Steel Decking" for field installation of shear connectors.
 - 3. Division 05 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other metal items not defined as structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.
- B. Architecturally Exposed Structural Steel: All Structural Steel exposed to view at the completion of project construction is designated as architecturally exposed structural steel.

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.
- B. Select and complete connections using schematic details indicated, Loads indicated and AISC's "Manual of Steel Construction, Allowable Stress Design," Part 4
- C. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer licensed in the jurisdiction where the project is located to perform structural analysis for structural-steel connections.

- D. Fabricator's and engineer's responsibility includes the inspection, analysis and verification of the load carrying capacity of the existing element connections for elements affected by this renovation and for the reactions indicated on the drawings.
 - 1. Existing Construction: Type 1 Rigid Framing in one direction, Type 2 Simple Framing in the other. Existing building was built in 1964.
 - 2. New Construction: Type 2, Simple Framing.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. For structural-steel connections indicated to comply with design loads, include structural Calculations signed and sealed by the qualified professional engineer responsible for their preparation. These calculations are for record only and will not be reviewed by the Architect or Engineer of Record.
- C. Welding certificates.
- D. Qualification Data: For Installer, fabricator and professional engineer.
- E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Direct-tension indicators.
 - 4. Tension-control, high-strength bolt-nut-washer assemblies.
 - 5. Shear stud connectors.
 - 6. Shop primers.
 - 7. Nonshrink grout.
- F. Source quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1.
- D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- E. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 - 3. AISC's "Specification for the Design of Steel Hollow Structural Sections."
 - 4. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
 - 5. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.

- B. Channels, Angles: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M or ASTM A 572/A 572M, Grade 50 (345).
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - 1. Weight Class: As indicated on drawings.
 - 2. Finish: [Black, except where indicated to be galvanized.
- F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
 - 1. Finish: Plain or Hot-dip zinc coating, ASTM A 153/A 153M, Class C where indicated.
- B. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8.) compressible-washer type.
 - 1. Finish: Plain or Mechanically deposited zinc coating, ASTM B 695, Class 50.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy hex head steel structural bolts with splined ends; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
 - 1. Finish: Plain or Mechanically deposited zinc coating, ASTM B 695, Class 50.
- D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- E. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Hooked.
 - 2. Nuts: ASTM A 563 (ASTM A 563M) heavy hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
 - 5. Finish: Plain.

2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
- B. Galvanizing Repair Paint: SSPC-Paint 20 ASTM A 780.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally exposed structural steel.
 - 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.
 - 2. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
- D. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- E. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- F. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- G. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

- I. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened or Slip critical.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials.
 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Apply a 1-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
 1. Fill vent holes and grind smooth after galvanizing.
 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- B. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Ultrasonic Inspection: ASTM E 164.
 4. Radiographic Inspection: ASTM E 94.

- D. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The contractor is responsible to inspect and verify that the existing framing matches that depicted on the existing building structural drawings, in all aspects including but not limited to member sizes, element conditions, connection type, detail and condition, column location beam and joist span and spacing, etc. Any discrepancy must be brought to the attention of the Architect prior to any detailing, engineering or fabrication.
- B. The contractor is responsible to inspect and verify that the condition of all the existing framing elements and their connections are not in any deteriorated condition that may in any way affect their load carrying capability. Any condition found that is deteriorated must be brought to the attention of the Architect prior to any detailing, engineering or fabrication.
- C. The contractor is responsible to inspect existing framing conditions in regards to member sizes, element conditions, connection type, detail and condition and any other aspect that affect the elements and connections designed by him, prior to engaging in the detailed connection design and fabrication.
- D. The contractor is responsible for the inspection, analysis and verification of the load carrying capacity of the existing element connections for elements affected by this renovation and for the reactions indicated on the drawings.
- E. The contractor shall perform the necessary tests to verify the weldability of the existing steel elements and make the necessary adjustments in the welding processes and equipment for the proper welding on existing elements.
- F. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary

construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

- B. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.

- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened or Slip critical where indicated or required.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth in architecturally exposed steel.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 - 4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Testing and Inspection Reports:
 - 1. Testing and Inspection reports must be submitted to the Owner and A/E no later than 48 hours after the inspection or testing.
 - 2. "Testing and Inspection Reports" must be titled as such. Use of language "Field Report" or "Observation Report" or similar, is not acceptable.
 - 3. The Report shall indicate the elements and areas that were inspected and list any items found to be not in compliance with the Contract Documents

and approved shop drawings, and the reason for non-compliance. The report shall contain the statement: "The following structural elements were inspected and found to be in compliance with the Contract Documents and approved shop drawings with the following exceptions:....." Use of language "observed", "appeared to be in compliance", "general compliance" or similar, is not acceptable.

- C. Any Report containing any non-compliance items must be clearly marked so on the front page and on the transmittal or e-mail. The A/E will not review and scrutinize every single Inspection Report to uncover non-compliance items.
- D. Non-Compliance List:
 - 1. The Testing and Inspection agency must maintain a list of all non-compliance items found, the date of inspection, the resolution, and the date item was resolved.
 - 2. The list must be distributed to the A/E at least bi-weekly
- E. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
 - 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- G. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- H. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

- C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 051200

SECTION 052100 - STEEL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Open web steel joists with bridging, attached seats, and anchors.
- B. Related Sections include the following:
 - 1. Division 01 Section "Quality Requirements".
 - 2. Division 05 Section "Steel Decking".
 - 3. Division 05 Section "Structural Steel Framing".
 - 4. Division 05 Section "Metal Fabrications".
 - 5. Division 09 Painting Sections.
- C. Products Furnished But Not Installed Under This Section:
 - 1. Anchor bolts for installation in **masonry and concrete**.

1.3 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Employ registered professional engineer, licensed to practice structural engineering in jurisdiction where Project is located, to engineer each component of steel joist.
 - 2. Fabricator: Responsible for designing system, including anchorage to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
 - 3. Fabricator: Responsible for inspecting, evaluating and reinforcing existing joist bridging to comply with current SJI requirements. This applies to all areas of the existing building regardless if modifications or additions under this section are indicated.
- B. Interface With Other Systems: Coordinate primer with finish paint.
 - 1. Provide templates and instructions for installing anchors in other work.

1.4 SUBMITTALS

- A. Shop Drawings: Stamp shop drawings with seal and signature of professional engineer responsible for design.

1. Indicate standard designation, configuration, sizes, spacing, and locations of joists.
 2. Include joist coding, bridging, and connections.
 3. Show extended ends, ceiling extensions, headers, end supports, and other accessories.
 4. Note web and chord member sizes of joist girders on shop drawings.
- B. Submit changed condition drawings.
- C. Informational Submittals: Submit following:
1. Certifications specified in Quality Assurance article.
 2. Qualification Data: Engineer's, fabricator's, and erector's qualification data.
- D. Existing Condition Inspection:
1. Submit a report signed and sealed by a professional engineer licensed to practice structural engineering in jurisdiction where Project is located, indicating the inspections, evaluations, repairs and reinforcing of existing joists and bridging, required under these specifications.

1.5 QUALITY ASSURANCE

- A. Perform all work according to SJI, these specifications and notes on drawings where more stringent.
- B. Engineer Qualifications: Registered professional engineer licensed to practice structural engineering in jurisdiction where Project is located, with minimum of five years experience in design of steel joists and joist girders.
- C. Fabricator Qualifications: Maintain full time engineering department.
1. Minimum five years documented experience in fabrication of steel joists.
- D. Erector Qualifications: Minimum five years documented experience in erection of steel joists for similar structures.
- E. Welder Qualifications: AWS certified within past 12 months for each type of weld required.
- F. Certifications: Submit following:
1. Certificates verifying AWS qualifications for each welder employed on Project.
 2. Fabricator's certification that products furnished for Project meet or exceed specified requirements.
 3. Engineering certifications.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Division 1 Related Section and SJI requirements.
1. Protect joists from distortion or damage.

1.7 PROJECT CONDITIONS

- A. Field verify measurements.
 - 1. Verify that field measurements are as indicated.
 - 2. Architect will not review or take responsibility for dimensions.
- B. Inspect, evaluate, supplement, and reinforce existing joist bridging to comply with current SJI requirements. This applies to all areas of the existing building regardless if modifications or additions under this section are indicated.
- C. Inspect, evaluate and repair existing joists as required to meet the original load capacity requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Open Web Joists Members: SJI Type K.
- B. Anchor Bolts, Nuts and Washers:
 - 1. Anchor Bolts: ASTM F1554.
 - 2. Standard Threaded Fasteners:
 - 3. Plain Washers: ANSI (B18.22.1).
- C. Welding Materials: AWS D1.1; type required for materials being welded.
- D. Primer Paint: SSPC Paint 15, Type 1, red oxide.
- E. Structural Steel for Supplementary Framing, Joist Leg Extensions and Bridging: Materials permitted by SJI for chord and web sections.
- F. Non-Shrink Grout: Pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing minimum compressive strength of 7000 PSI at 28 days.
 - 1. Acceptable Products:
 - a. Masterflow 713 by Master Builders, Cleveland, OH.
 - b. Five Star Grout by US Grout Corp, Fairfield, CT.
 - c. Euco N.S. by Euclid Chemical Co., Cleveland, OH.
 - d. Accepted Substitute in accordance with Section 01600.
 - e. [No Substitutions.]

2.2 OPEN WEB JOIST FABRICATION

- A. Fabricate joists in accordance with SJI specifications and with conditions shown.
 - 1. Ceiling Extensions: Provide chord extensions for joists where ceilings are suspended from joists, if required.
 - 2. Holes: Drill holes in chords necessary for attachment of other work.
 - a. Deduct area of holes from area of chord when calculating strength of member.

3. Extended Ends: Design as cantilever beam with reactions carried back to first interior panel point of joist.
 - a. Do not drill holes in extended (cantilevered) top chords without approval of Architect.
- B. Bridging: Provide bridging anchors at ends of each bridging line at both top and bottom chords.
- C. Supplementary Framing: Frame special sized opening in joist chord framing as detailed.
- D. Finish: Shop prime steel joists except surfaces that will be field welded or in contact with concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with Work in accordance with Division 1 related Section.
- B. Inspect, evaluate, supplement, and reinforce existing joist bridging to comply with current SJL requirements. This applies to all areas of the existing building regardless if modifications or additions under this section are indicated.
- C. Inspect, evaluate and repair existing joists as required to meet the original load capacity requirements.

3.2 PREPARATION

- A. Setting Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces.
 1. Clean bottom surface of base and bearing plates.
 2. Non-Shrink Grout: Pack solidly between bearing surfaces and bases or plates so that no voids remain. Comply with grout manufacturer's instructions.

3.3 OPEN WEB JOIST ERECTION

- A. Placing Joists:
 1. Erect and bear joists on supports.
 2. Allow for erection loads.
 3. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment until completion of erection and installation of permanent bridging and bracing.
 4. Adjust and align in accurate locations and spacing before permanently fastening joists on supporting Work. Position and field weld joist chord extensions and wall attachments.
 5. Supplementary Framing: Frame roof openings greater than (12 inches) in any direction with supplementary framing.

- a. Coordinate openings with requirements of steel deck.
 - b. Openings: Reviewed and approved by Architect.
 6. Bridging: Install permanent bridging before construction loads are imposed, simultaneously with joist erection.
 7. Do not field cut or alter structural members without approval of Architect.
- B. Fastening Joists:
1. Bolted Connections: Fasten joists to columns by bolting when required.
 2. Welded Connections: Fasten joists by field welding to supporting steel framework.
 3. Non-Shrink Grout: Secure joists resting on masonry or concrete by bedding in grout and anchoring to masonry. Slope: Create slope for roof by means of steel shims or use of sloping seats.
 1. Sloping seats or beveled seats are mandatory where slope exceeds (1/4 inch in one foot).
- D. Erection Tolerances: Comply with SJI and AISC standards.
- E. Touch-Up Painting: After erection, prime welds, abrasions, and marred shop-primed surfaces except surfaces to be in contact with concrete.

3.4 FIELD QUALITY CONTROL

- A. Perform field quality control in accordance with Division 1 related Section.
- B. Visual Inspection:
1. Inspect 100 percent of welds, shop fabricated assemblies, and bridging.
 2. Inspect erected joists for size and spacing.
- C. Submit written reports of inspections, signed by the independent testing and inspection agency.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Roof deck.
- 2. Composite floor deck.

- B. Related Sections include the following:

- 1. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
- 2. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
- 3. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
- 4. Division 09 painting Sections for repair painting of primed deck.

1.3 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: For each type of steel deck, signed by product manufacturer.
- D. Welding certificates.
- E. Field quality-control test and inspection reports.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
- G. Research/Evaluation Reports: For steel deck.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
 - 2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.
- D. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

1.6 COORDINATION

- A. Coordinate layout and installation of openings through the steel deck.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Deck:
 - a. Consolidated Systems, Inc.
 - b. Epic Metals Corporation.
 - c. Nucor Corp.; Vulcraft Division.
 - d. Roof Deck, Inc.
 - e. United Steel Deck, Inc.

- f. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230) G90 (Z275) zinc coating.
 2. Deck Profile: As indicated on the drawings.
 3. Profile Depth: As indicated on the drawings.
 4. Design Uncoated-Steel Thickness: As indicated on the drawings.
 5. Span Condition: As indicated on the drawings.
 6. Side Laps: Overlapped.

2.3 COMPOSITE FLOOR DECK

- A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
 2. Profile Depth: As indicated on the drawings.
 3. Design Uncoated-Steel Thickness: As indicated on the drawings.
 4. Span Condition: As indicated on the drawings.

2.4 NON-COMPOSITE FORM DECK

- A. Noncomposite Steel Form Deck: Fabricate ribbed-steel sheet non-composite form-deck panels to comply with "SDI Specifications and Commentary for Non-composite Steel Form Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
 1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 80 minimum, with underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 2. Profile Depth: 9/16 inc or as indicated on the drawings.
 3. Design Uncoated-Steel Thickness: 22 Ga - 0.0295 inch.
 4. Span Condition: As indicated on the drawings.
 5. Side Laps: Overlapped and fastened at 12" o.c.
 6. Supports: Welded using welding washers at 12" o.c.

2.5 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile indicated on the drawings.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch (1.90 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.
- J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and level sloped recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.
- K. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.
- L. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.
- M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting existing and new frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No.30, manufacturer's written instructions, and requirements in this Section.

- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as indicated on the drawings.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches (450 mm), and as indicated on the drawings.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
 - 1. End Joints: Lapped 2 inches (51 mm) minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 6 inches (305 mm) apart with at least one fastener at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as indicated on the drawings.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches (910 mm), and as indicated on the drawings.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
 1. End Joints: Butted.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior load-bearing wall framing.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design Cold-Formed Metal Framing, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Load-Bearing Wall Framing at masonry veneer: Horizontal deflection of 1/1000 of the wall height.
 - b. Exterior Load-Bearing Wall Framing at metal wall panels and composite metal wall panels: Horizontal deflection of 1/360 of the wall height.
 - 3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1-1/2 inches.
- C. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 - 1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
 - 1. Expansion anchors.
 - 2. Power-actuated anchors.
 - 3. Mechanical fasteners.
 - 4. Miscellaneous structural clips and accessories.

1.6 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.
- E. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- F. AISI Specifications and Standards: Comply with AISI's "North American Specification

for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
 1. Clark Dietrich Building Systems.
 2. Marino\Ware; a division of Ware Industries.
 3. JN Linrose Manufacturing.

2.2 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 1. Grade: ST50H.
 2. Coating: G60, A60, AZ50, or GF30.
- C. Steel Sheet for Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 1. Grade: 50, Class 1 or 2.
 2. Coating: G90.

2.3 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness: 0.0451 inch and as indicated on drawings.
 2. Flange Width: 1-5/8 inches () minimum.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated,

unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0451 inch and as indicated on drawings.
 2. Flange Width: 1-1/4 inches () minimum.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0451 inch and as indicated on drawings.
 2. Flange Width: 1-5/8 inches () minimum.

2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003 / A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Bracing, bridging, and solid blocking.
 2. Web stiffeners.
 3. Anchor clips.
 4. Stud kickers, knee braces, and girts.

2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 55, threaded carbon-steel hex-headed bolts in steel substrates and headless bolts, with encased end threaded, in concrete and masonry substrates, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.
- B. Shims: Load bearing, high-density multimonomer plastic, non-leaching.
- C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.7 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
 - 4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

- J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
 - 1. Anchor Spacing: To match stud spacing.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 - 1. Stud Spacing: 12 inches.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
- I. Install horizontal bridging in stud system, spaced as indicated on Shop Drawings. Fasten at each stud intersection.
 - 1. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or

- flanges.
- 2. Bridge exterior framing studs to metal framing studs

- J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for countertops.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Shelf angles.
6. Elevator machine beams, hoist beams, guide rails and supports.
7. Steel shapes for supporting elevator door sills.
8. Metal ladders.
9. Metal Stairs and Gratings
10. Metal bollards.
11. Steel safety mounting eyebolt anchorages.
12. Loose bearing and leveling plates for applications where they are not specified in other Sections.

- B. Products furnished, but not installed, under this Section:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

- C. Related Sections:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing."
3. Section 055100 "Metal Stairs."
4. Section 057300 "Decorative Metal Railings."
5. Section 129300 "Site Furniture" for bicycle racks.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders and mounting brackets and anchorages for window-washing, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Delegated Design: Design elevator guiderails, supports and mounting brackets for elevator, including comprehensive engineering analysis by a qualified professional engineer.
- C. Delegated Design: Design supports for benches, counter-tops and miscellaneous casework including comprehensive engineering analysis by a qualified professional engineer. Elements supporting benches, counter-tops and miscellaneous casework are to be designed for the weights of all attached materials and a live load of 30 psf uniform or 300 lbs concentrated. Supports for these elements shall be considered at the points indicated on the drawings. Provide miscellaneous supports above the ceiling as required. Supports above the ceiling shall only be connected to steel members. Do not connect to slab.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Grout.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Delegated design systems include the following:
 - 1. Steel framing and supports for overhead doors.
 - 2. Steel framing and supports for countertops.
 - 3. Steel framing and supports for mechanical and electrical equipment.
 - 4. Elevator machine beams, hoist beams, guide rails and supports.
 - 5. Steel shapes for supporting elevator door sills.
 - 6. Metal ladders.
 - 7. Metal Stairs and Gratings
 - 8. Steel safety mounting eyebolt anchorages.
 - 9. Steel framing and supports for fixed open study benches and tables.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Welding certificates.

- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 1. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm).

2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.
3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0966-inch (2.5-mm) minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 1. Provide stainless-steel fasteners for fastening aluminum.
 2. Provide stainless-steel fasteners for fastening stainless steel.
 3. Provide stainless-steel fasteners for fastening nickel silver.
 4. Provide bronze fasteners for fastening bronze.
- B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1).
 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- C. Eyebolts: ASTM A 489.
- D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- E. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Wood Screws: Flat head, ASME B18.6.1.
- G. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- H. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- I. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- J. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- K. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

- L. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 09 painting sections.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
1. Provide mitered and welded units at corners.
 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS

A. General:

1. Comply with ANSI A14.3 unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.
3. Delegated Design: Design ladders including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Steel Ladders:

1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch (12.7-by-64-mm) steel flat bars, with eased edges.
3. Rungs: steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
7. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
8. Galvanize exterior and elevator pit ladders, including brackets and fasteners.

2.9 METAL STAIRS AND GRATINGS

A. Provide metal exterior stairs where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Delegated Design: Design stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Fabricate stairs, including railings from steel.
3. Fabricate treads and platforms from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1/2 inch in least dimension.
4. Comply with applicable railing requirements in Division 05 Section "Pipe and Tube Railings."

B. Galvanize exterior steel, including treads, railings, brackets, and fasteners.

2.10 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe 1/4-inch (6.4-mm) wall-thickness rectangular steel tubing.

1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate.
2. Where bollards are indicated to receive controls for door operators, provide necessary cutouts for controls and holes for wire.

- B. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.

2.11 STEEL SAFETY EYEBOLT ANCHORAGES.

- A. Delegated Design: Design mounting brackets and anchorages for fall protection, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated and as defined by OSHA.
- B. Basis-of-Design Products: Subject to compliance with requirements, provide the named products or comparable products by the following:
 - 1. Diversified Fall Protection.
 - a. 3" diameter galvanized steel eyebolt anchor capable of restraining 5,400 lbs. in any direction. To be used as a safety tie-off for working on exterior of the building.

2.12 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.

2.13 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Galvanize loose steel lintels located in exterior walls.

2.14 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.15 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.16 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
 - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING METAL BOLLARDS

- A. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.
- B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

3.4 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

3.5 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Preassembled steel stairs with precast epoxy resin terrazzo treads and risers.
3. Exterior Industrial-type stairs and ramps with steel grating treads.
4. Steel tube railings attached to metal stairs.
5. Steel tube handrails attached to walls adjacent to metal stairs.

B. Related Sections:

1. Section 03 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Section 05 "Decorative Metal Railings" for pipe and tube railings not attached to metal stairs or to walls adjacent to metal stairs.
3. Section 06 "Rough Carpentry" for wood blocking for anchoring railings.
4. Section 09 "Resinous Matrix Terrazzo Flooring" for terrazzo treads and landings.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Handrails and Top Rails of Guards:

- a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.

- b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
- c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

- a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
- b. Infill load and other loads need not be assumed to act concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For metal stairs and the following:

- 1. Prefilled metal-pan stair treads.
- 2. Metal floor plate treads.
- 3. Paint products.
- 4. Grout.

B. LEED Submittals:

- 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Verification: For the following products, in manufacturer's standard sizes:

- 1. Grating treads.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

- 1. Industrial-Type Stairs (Exterior): Industrial class.
- 2. Ornamental Stairs: Architectural class.

- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- F. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).
- G. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- H. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

- I. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, guard railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 1. Join components by welding unless otherwise indicated.
 2. Use connections that maintain structural value of joined pieces.
 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.

- F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Alfab, Inc.
 2. American Stair, Inc.
 3. Sharon Companies Ltd. (The).
- B. Stair Framing:
1. Fabricate stringers of steel tubes.
 - a. Provide closures for exposed ends of tube stringers.
 2. Construct platforms of steel tube headers and miscellaneous framing members as needed to comply with performance requirements.
 3. Weld stringers to headers; weld framing members to stringers and headers.
 4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch (1.7 mm).
1. Steel Sheet: Uncoated cold-rolled steel sheet.
 2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 3. Shape metal pans to include nosing integral with riser.
- D. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from welded or pressure-locked steel grating with openings in gratings no more than 5/16 inch (8 mm) in least dimension.
2. Surface: Serrated.
3. Finish: Galvanized.
4. Fabricate grating treads with rolled-steel floor plate nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
5. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

2.7 STAIR RAILINGS

- A. Comply with applicable requirements in Section 057300 "Decorative Metal Railings."

2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.
- C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 1. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 1. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."
- E. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- G. Place and finish concrete fill for treads and platforms to comply with Section 03 "Cast-in-Place Concrete."
- H. Install precast concrete treads with adhesive supplied by manufacturer.

3.2 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055100

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Steel pipe and tube railings.

- B. Related Sections:

- 1. Section 055100 "Metal Stairs" for steel tube railings associated with metal stairs.
- 2. Section 057300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes.
- 3. Section 061000 "Rough Carpentry" for wood blocking for anchoring railings.
- 4. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

- 1. Steel: 72 percent of minimum yield strength.

- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

- 1. Handrails and Top Rails of Guards:

- a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
- b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
- c. Uniform and concentrated loads need not be assumed to act concurrently.

- 2. Infill of Guards:

- a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
- b. Infill load and other loads need not be assumed to act concurrently.

- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- D. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Fittings and brackets.
 - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of finishing and connecting members at intersections.
- E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Pipe and Tube Railings:
 - a. Pisor Industries, Inc.
 - b. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - c. York Metal Fabricators
 - d. Maryland Metal Products

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STEEL AND IRON

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.4 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- F. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: Where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.

- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Form changes in direction as follows:
 - 1. By bending or by inserting prefabricated elbow fittings.
- J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of railing members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize steel and iron railings, including hardware, after fabrication.
 - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 - 4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - 5. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 1. Shop prime uncoated railings with universal shop primer unless indicated.
 - 2. Do not apply primer to galvanized surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, attached to post with set screws.
- D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.
- C. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 2. For hollow masonry anchorage, use toggle bolts.
 3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
 4. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
 5. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

- A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Post-supported railings, side-mounting with glass infill.
 - 2. Tempered glass infill panels.
 - 3. Aluminum decorative railings with stainless-steel handrails.
 - 4. Decorative stainless steel handrails with LED lights.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for metal stair supports and metal backing for anchoring railings.
 - 2. Division 05 Section "Metal Stairs" for steel tube railings included with metal stairs and pipe and tube components.
 - 3. Division 09 Section "Gypsum Board Assemblies" for metal backing for anchoring railings.

1.3 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Stainless Steel: 60 percent of minimum yield strength.
 - 2. Steel: 72 percent of minimum yield strength.
 - 3. Delete subparagraph below if no glass-supported railings. Verify with Project's structural engineer and railing manufacturers selected. Below is based on requirement in model codes for safety factor of 4.
 - 4. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."1.
 - 5. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.

- C. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 3. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Uniform load of 25 lbf/sq. ft. (1.2 kN/sq. m) applied horizontally.
 - c. Infill load and other loads need not be assumed to act concurrently.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

- A. Product Data: For the following:
1. Manufacturer's product lines of railings assembled from standard components.
 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Verification: For each type of exposed finish required.
1. Fittings and brackets.
 2. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.
- D. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- E. Qualification Data: For professional engineer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

1.8 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel and Glass Ornamental Railings:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "Stainless Steel Railings" as manufactured by HDI Railing Systems or comparable product by one of the following:

- a. Livers Bronze Co.
- b. Newman Brothers Inc.
- c. Wylie Systems.
- d. Synergi Pre-Engineered Railing system as manufactured by Accent Architectural.

B. Stainless Steel Hand Rails

1. Stainless steel handrails: Handrails made from stainless steel extrusions.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by the following:
 - 1) The Wagner Company, Milwaukee, WI (888) 243-6914

C. Aluminum Decorative Railings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Architectural Metal Works. b. Blumcraft of Pittsburgh.
 - b. Braun, J. G., Company; a division of the Wagner Companies.

D. Stainless Steel Hand Rails with LED Lights

1. Stainless steel handrails: Handrails made from stainless steel extrusions.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by the following:
 - 1) The Wagner Company, Milwaukee, WI (888) 243-6914

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails, unless otherwise indicated.
 1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
 2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
 3. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.

2.3 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 304.
- B. Pipe: ASTM A 312/A 312M, Grade TP 304.
- C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.
- D. Plate and Sheet: ASTM A 666, Type 304.

2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Extruded Bars and Shapes, Including Extruded Tubing: ASTM B 221, Alloy 6063- T5/T52.
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209, Alloy 5005-H32.
- F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.5 STEEL

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513, Type 5 (mandrel drawn).
- B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Post Steel to be type A36 - 2" (50mm) by 1/4" (6mm). Hardware attachment surface to be on inside of post formed from the post bar. Attaching hardware to be fastened by vertically sliding clamps. All steel to be powder coated to required color.
- E. Surface and side mount fastening plates and clamps to be made from steel type A36. All steel to be powder coated to color as selected by Architect from manufacturer's full selection.
- F. Clamps, end block at top of post and handrail attachment all to be Stainless steel grade UNS 1.4305, type 304. Surface to be 240 grain/grit finish to match handrail finish.

2.6 GLASS AND GLAZING MATERIALS

- A. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and

edge compression according to ASTM C 1048 and for impact strength according to 16 CFR 1201 for Category II materials.

1. Clear Glass: Class 1 (clear).
 2. Thickness for Glass Infill Panels: 3/8" (9 mm) to 1/2" (13 mm).
 3. Provide safety glass permanently marked with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
- B. Glazing Gaskets for Glass Infill Panels: Provide glazing gaskets and related accessories recommended or supplied by railing manufacturer for installing glass infill panels in post-supported railings.

2.7 FASTENERS

- A. General: Provide the following:
1. Stainless-Steel Components: Type 304 stainless-steel fasteners.
 2. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fastening bolts to be stainless steel or other high strength material as determined by engineering requirements.
- D. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work, unless otherwise indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Wood Rails: Hardwood rails of species and profile indicated or, if not indicated, as selected by Architect from manufacturer's standard, with manufacturer's standard transparent finish.
1. Species and Finish: Cherry with custom stained finish.
 2. Profile: Manufacturer's standard round shape.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
- C. Perforated Metal for Stair Risers: Harrington and King, Straight slot pattern, 3/32" x 3/4" slot; Stainless steel.
- D. Anchors shall be fabricated from stainless steel or other materials as determined by engineering requirements with capability to sustain, without failure, load imposed within a safety factor of 4, as determined by testing per ASTM E488.

2.9 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- F. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- G. All bends required for either sloped rail or other necessary changes in direction to be manufactured from stainless steel with a 240grit finish to match posts and other stainless steel fittings. Transitions from wood to stainless steel either at posts or at bends to be smooth and without burrs. Close exposed ends of hollow railing members with prefabricated end fittings.
- H. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

2.10 GLAZING PANEL FABRICATION

- A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.
- B. Infill Panels: Provide tempered glass panels.

2.11 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.12 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Grind and polish surfaces to produce uniform finish indicated, free of cross scratches.
- C. Directional Satin Finish: Manufacturers standard.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.13 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the
- B. Aluminum Association for designating aluminum finishes.
- C. Mechanical Finish: AA-M3x (Mechanical Finish: as specified); sand top rails, handrails, and intermediate rails in one direction only, parallel to length of railing, with 120- and 320-grit abrasive. After installation, polish railings with No. 0 steel wool immersed in paste wax, then rub to a luster with a soft dry cloth.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

- A. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

3.5 ANCHORING RAILING ENDS

- A. Anchor railing ends to concrete and masonry with brackets on underside of rails connected to railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends using nonwelded connections.

3.6 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets to building construction as follows:
 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 2. For hollow masonry anchorage, use toggle bolts.
 3. For steel-framed gypsum board partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

3.7 INSTALLING GLASS PANELS

- A. Post-Supported Glass Railings: Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles. Erect posts and other metal railing components, then set factory-cut glass panels. Do not cut, drill, or alter glass panels in field. Protect edges from damage.

3.8 FIELD QUALITY CONTROL

3.9 CLEANING

- A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.
- B. Clean and polish glass.
- C. Clean wood rails by wiping with a damp cloth and then wiping dry.
- D. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.10 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057300

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rooftop equipment bases and support curbs.
 - 2. Wood blocking, cants and nailers.
 - 3. Plywood backing panels.
- B. Related Requirements:
 - 1. Section 06 "Sheathing."

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. SPIB: The Southern Pine Inspection Bureau.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. LEED Submittals:

1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit EQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
1. Wood-preservative-treated wood.
 2. Fire-retardant-treated wood.
 3. Engineered wood products.
 4. Power-driven fasteners.
 5. Powder-actuated fasteners.
 6. Expansion anchors.
 7. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship

- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
- C. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
 - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
 - 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.
 - 2. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
 - 6. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and the following species:
 - 1. Spruce-pine-fir; NLGA.
 - 2. Eastern softwoods; NeLMA.
- C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
 - 1. Eastern softwoods; No. 2 Common grade; NeLMA.
 - 2. Northern species; No. 2 Common grade; NLGA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

- 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide Type 304 stainless steel fasteners.

- B. Nails, Brads, and Staples: ASTM F 1667.

- C. Power-Driven Fasteners: NES NER-272.

- D. Screws for fastening to metal framing: ASTM C954, length as recommended by screw manufacturer for material being fastened.

- E. Wood Screws: ASME B18.6.1.

- F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

- G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

- 1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.7 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spun-bonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit.

Locate furring, nailers, blocking and similar supports to comply with requirements for attaching other construction.

- B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- G. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment.
- C. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall sheathing.
 - 2. Exterior soffit / ceiling sheathing.
 - 3. Roof-side parapet wall sheathing.
 - 4. Sheathing joint and penetration treatment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WALL SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. G-P Gypsum Corporation; Dens-Glass Gold.
 - b. National Gypsum Company; Gold Bond e(2)XP.
 - c. United States Gypsum Co.; Securock.
 - 2. Type and Thickness: Type X, 5/8 inch thick.
 - 3. Size: 48 by 120 inches for vertical installation.

2.2 FIRE-RATED WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. G-P Gypsum Corporation; DensGlass Fireguard.
 - b. National Gypsum Company; Gold Bond Fire-Shield e(2)XP.
 - c. United States Gypsum Co.; Securock.
2. Type and Thickness: Type X, 5/8 inch) thick.
3. Size: 48 by 120 inches)for vertical installation.

2.3 EXTERIOR SOFFIT / CEILING SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. G-P Gypsum Corporation; Dens-Glass Gold.
 - b. National Gypsum Company; Gold Bond e(2)XP.
 - c. United States Gypsum Co.; Securock.
2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
3. Size: 48 by 120 inches (for horizontal installation.

2.4 ROOF-SIDE PARAPET WALL SHEATHING

A. Glass-Mat Water Resistant Gypsum Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. G-P Gypsum Corporation; DensDeck Prime.
 - b. United States Gypsum Co.; Securock Roof Board.
2. Thickness: 5/8 inch) thick.
3. Size: 48 by 96 inches for vertical installation.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners of Type 304 stainless steel.

B. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

2.6 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 x 10 or 10 x 20 threads/inch) of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 1. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 GYPSUM SHEATHING INSTALLATION

- A. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.
- B. Comply with GA-253 and with manufacturer's written instructions.
 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
 2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 3. Install boards with a 1/4-inch gap where they abut masonry or similar materials

that might retain moisture, to prevent wicking.

- C. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- D. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
 - 1. Space fasteners approximately 8 inches)o.c. and set back a minimum of 3/8 inch)from edges and ends of boards.
- E. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
 - 1. Space fasteners approximately 8 inches)o.c. and set back a minimum of 3/8 inch)from edges and ends of boards.
- F. Seal all sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Interior standing and running trim.
2. Flush wood paneling.
3. Plastic-laminate cabinets and countertops.
4. Solid-surfacing-material countertops and sills.
5. Resin Panels
6. Fiber cement solid surfacing.
7. Closet and utility shelving.
8. Shop finishing of interior woodwork.

- B. Related Sections include the following:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including finishing materials and processes.

- B. Product Data: For panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate, solid-surfacing material, finishing materials and processes.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.

2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers and other items installed in architectural woodwork.
4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

D. Samples for Verification:

1. Lumber with or for transparent finish, not less than 50 sq. in. (300 sq. cm), for each species and cut, finished on 1 side and 1 edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
3. Veneer-faced panel products with or for transparent finish, 8 by 10 inches (200 by 250 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.
4. Lumber and panel products with shop-applied opaque finish, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels, for each finish system and color, with 1/2 of exposed surface finished.
5. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish and specified edge material applied to 1 edge.
6. Solid-surfacing materials, 6 inches (150 mm) square.

E. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives and glues used at Project site, including printed statement of VOC content.
2. Product Data for Credit EQ 4.4: For composite-wood products, documentation indicating that product contains no urea formaldehyde.
3. Certificates for Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.
 - a. Include statement indicating costs for each certified wood product.

F. Product Certificates: For each type of product, signed by product manufacturer.

G. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

H. Qualification Data: For Installer and fabricator.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.
- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers and transparent-finished wood doors that are required to be of same species as woodwork.

- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 - 1. Provide AWI Quality Certification Program labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.
- E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
- F. Forest Certification: Provide interior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria."
- G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species for Opaque Finish: Any closed-grain hardwood.
- C. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
- D. Wood Veneer (**WV-1**):
 - 1. Basis-of-Design:
 - a. Manufacturer: Vinterio Veneer
 - b. Color: Match Architect's Sample - Stratus Superior Brown Ash
 - c. Grade: Premium
- E. Wood, Solid (**WS-1**): Clear Maple, Premium Grade; Match Architect's control sample.
- F. Wood, Solid (**WS-2**): Cherry, Premium Grade; Match Architect's control sample.
- G. High-Pressure Decorative Laminate (**PL-1, PL-2 and PL-3**): NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Laminate Cladding for Exposed Surfaces:
 - a. Horizontal Surfaces: Grade HGS.
 - b. Postformed Surfaces: Grade HGP.
 - c. Vertical Surfaces: Grade HGS.
 - d. Edges: Grade HGS.
 - e. Pattern Direction: As indicated.
 - 2. Basis of Design:

- a. Wilsonart Laminate
 - 1) PL-1: "Tan Echo" 7941K-18
 - 2) PL-2: "Carbon EV" 4820-60
 - 3) PL-3: "Carbon EV" 4820-60

 - H. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2 (**SS-1, SS-2 and SS-3**).
 - 1. Basis of Design: As indicated on Finish schedule. - I. Resin Panels: Solid resin panels (**RP-1**)
 - 1. Basis of Design:
 - a. 3Form; Product and color as indicated on Finish Schedule.

 - J. Fiber Cement Solid Surfacing Material (**FS-1**): Homogeneous solid sheets of consisting of Portland cement, silica sand, water, and fillers.
 - 1. Basis of Design Manufacturers:
 - a. Fireslate-2, Inc., East Wareham, MA.
 - b. Type: Fireslate
 - c. Colors and Patterns: Light Grey - Match Architect's samples.
 - d. Thickness: As noted in drawings
 - e. Grit: As noted in drawings

 - K. Tempered Float Glass for Cabinet Doors and Glass Panels: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 6 mm thick, unless otherwise indicated.

 - L. Glass Clips for Frameless Glass Partitions and Panels: Equal to Oversized Fixed Panel U-Clamps as manufactured by C.R. Laurence Company.
 - 1. Finish: Satin Chrome.
- 2.2 CABINET HARDWARE AND ACCESSORIES
- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
 - B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.
 - C. Back-Mounted Pulls: BHMA A156.9, B02011.
 - D. Wire Pulls: Back mounted, solid metal, size to match prefabricated casework pulls.
 - E. Catches: Magnetic catches, BHMA A156.9, B03141.
 - F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

- G. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.
- H. Drawer Slides: BHMA A156.9, B05091.
 - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
 - 2. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
 - 3. File Drawer Slides: Grade 1HD-100; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
 - 4. Keyboard Slides: Grade 1HD-100; for computer keyboard shelves.
- I. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.
- J. Door Locks: BHMA A156.11, E07121.
- K. Drawer Locks: BHMA A156.11, E07041.
- L. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
- M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Match prefabricated casework hardware finishes.
- N. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.
 - 1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
 - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 - 3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment type:
 - 1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln drying.
 - 2. Interior Type A: Low-hygroscopic formulation.
 - 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking plant certified by testing and inspecting agency.

4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
 5. Kiln-dry materials before and after treatment to levels required for untreated materials.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
1. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2070 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively.
 2. For panels 13/16 to 1-1/4 inches (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi (9 MPa); modulus of elasticity, 250,000 psi (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf (1100 and 780 N), respectively.
 3. Product: Subject to compliance with requirements, provide "Duraflake FR" by Weyerhaeuser.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Wood Glues: 30 g/L.
 2. Contact Adhesive: 250 g/L.
- E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.

- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated.
- E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.

2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Premium.
- B. Wood Species and Cut: White maple, plain sawn.
- C. For trim items wider than available lumber, use veneered construction. Do not glue for width.
- D. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- E. Assemble casings in plant except where limitations of access to place of installation require field assembly.
- F. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.

2.7 COMPOSITE PARTICLEBOARD SHOP FINISHING

- A. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

C. Transparent Finish:

1. Grade: Premium.
2. AWI Finish System: Catalyzed polyurethane.
3. Staining: Match approved sample for color. Water based.

D. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

2.8 WOOD CABINETS FOR TRANSPARENT FINISH

A. Grade: Premium.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Wood Species and Cut for Exposed Surfaces: White maple, quarter sliced.

1. Grain Direction: Horizontally for drawer fronts, doors, and fixed panels.
2. Matching of Veneer Leaves: Book match.
3. Vertical Matching of Veneer Leaves: End match.
4. Veneer Matching within Panel Face: Running match.

2.9 PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Premium.

B. High-Pressure Decorative Laminate Grade: HGS.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As selected by Architect from manufacturer's full range in the following categories:

D. Edge Treatment: Same as laminate cladding on horizontal surfaces.

E. Core Material at Sinks: Medium-density fiberboard made with exterior glue.

F. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.

2.10 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Premium.

B. Solid-Surfacing-Material Thickness: 3/4 inch (19 mm) unless indicated otherwise.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. As selected by Architect from manufacturer's full range.
- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
 1. Fabricate tops with loose backsplashes for field application.
- E. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.11 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
- D. Transparent Finish:
 1. Grade: Premium.
 2. AWI Finish System: Conversion varnish.
 3. Staining: Match Architect's sample.
 4. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 5. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
 - a. Apply wash-coat sealer after staining and before filling.
 6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 60 inches (1500 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
 - 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
 - 2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).
- H. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening, unless otherwise indicated.
 - 1. Install flush paneling with no more than 1/16 inch in 96-inch (1.5 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.
- I. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
 - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- J. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
 4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
- K. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Modified bituminous sheet waterproofing for below-grade applications.
 - 2. Modified bituminous sheet waterproofing for above grade exterior wall assemblies with masonry back-up.

1.3 DEFINITIONS

- A. ABAA: Air Barrier Association of America

1.4 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Sheet Waterproofing Assembly Air Leakage: Not to exceed 0.01 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft.; ASTM E 283.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 1. Include details of interfaces with other materials that form part of air barrier.

2. Include details of mockups.
 - C. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.
 - D. Qualification Data: For Applicator.
 - E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.
 - F. Samples: For each exposed product and for each color and texture specified, including the following products:
 1. 8-by-8-inch square of waterproofing and flashing sheet.
 2. 8-by-8-inch square of insulation.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Sample Warranties: For special warranties.
- 1.7 QUALITY ASSURANCE
- A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance and that is an ABAA-licensed contractor, employs certified and registered installers, and complies with ABAA's Quality Assurance Program.
 - B. Mockups: Before beginning installation of air barrier, Build integrated mockups of exterior wall assembly as shown on Drawings , incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of sheet waterproofing membrane.
 1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
 2. Include junction with roofing membrane, building corner condition,.
 3. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
- 1.8 PRECONSTRUCTION TESTING
- A. Preconstruction Testing Service: Contractor will engage a qualified testing agency to perform preconstruction testing on field mockups.
 - B. Mockup Testing: sheet waterproofing assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Store rolls according to manufacturer's written instructions.
- D. Protect stored materials from direct sunlight.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Minimum 40-mil nominal thickness, consisting of SBS modified bitumen, self-adhering sheet membrane complete with a blue engineered thermoplastic film, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide the following:

- a. Henry Company; Blueskin SA or SA LT for low temperature applications.
2. Physical Properties:
 - a. Tensile Strength, Membrane: 500 psi minimum; ASTM D 412, Die C, modified.
 - b. Membrane Thickness: 0.0394 inches, 40 mils.
 - c. Ultimate Elongation: 200 percent minimum; ASTM D 412, Die C, modified.
 - d. Low-Temperature Flexibility: Pass at minus 22 deg F; ASTM D 1970.
 - e. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
 - f. Puncture Resistance: 40 lbf minimum; ASTM E 154.
 - g. Water Absorption: 0.1 percent weight-gain maximum after 48-hour immersion at 70 deg F ; ASTM D 570.
 - h. Water Vapor Permeance: 0.86 perms maximum; ASTM E 96/ E 96M, water method and 0.03 perms maximum; ASTM E 96 / E96M, dessicant method.
 - i. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.
 1. Henry Company, Aquatac Primer
- C. Sealant:
 1. Henry Company, BES Sealant

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Rolled composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing. with an apparent opening size not exceeding No. 100)sieve laminated to one side of the core and a polymeric film bonded to the other side.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Henry Company; HEDB500.
 2. Physical Properties:
 - a. Grab tensile strength: 110 lbs.
 - b. Puncture strength: 65 lbs.
 - c. Trapezoidal tear: 50 lbs.

- d. Elongation at break: 60%
- e. Permeability: 0.3 cm/sec.
- f. Flow rate; 150 gallons per minute/square foot.
- g. Compressive strength: 15,000 lbs/square foot
- h. Flow capacity per unit width: 16 gpm/ft.

2.5 INSULATION

- A. Insulation, General: Comply with Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
 - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- F. Bridge and cover expansion joints and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:

- a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- F. Seal edges of sheet-waterproofing terminations with mastic.
- G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches ()beyond repaired areas in all directions.
- I. Immediately install protection course with butted joints over waterproofing membrane.

3.4 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch ()of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and

inspections and prepare test reports.

- B. Inspections: Sheet waterproofing materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
 2. Continuous structural support of air barrier system has been provided.
 3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
 4. Site conditions for application temperature and dryness of substrates have been maintained.
 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 6. Surfaces have been primed, if applicable.
 7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 8. Termination mastic has been applied on cut edges.
 9. Strips and transition strips have been firmly adhered to substrate.
 10. Compatible materials have been used.
 11. Transitions at changes in direction and structural support at gaps have been provided.
 12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
 13. All penetrations have been sealed.
- C. Tests: As determined by Contractor's testing agency from among the following tests:
1. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to ASTM E 783.
 2. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.
- D. Sheet Waterproofing will be considered defective if they do not pass tests and inspections.
1. Remove and replace deficient sheet waterproofing components for retesting as specified above.
- E. Repair damage to sheet waterproofing caused by testing; follow manufacturer's written instructions.

3.6 PROTECTION, REPAIR, AND CLEANING

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Protect installed from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Correct deficiencies in or remove waterproofing that does not comply with

requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071326

SECTION 071660 - CRYSTALLINE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes crystalline waterproofing at interior face of elevator pits (walls and floor) unless indicated otherwise.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for forms and for concrete placement.
 - 2. Division 07 sheet waterproofing Sections for flexible flashing that may be part of adjoining waterproofing work.
 - 3. Division 07 Section "Joint Sealants" for elastomeric sealants.
 - 4. Division 31 Section "Earth Moving" for excavating and backfilling.

1.3 SYSTEM REQUIREMENTS

- A. Interface With Other Systems:
 - 1. Coordinate waterproofing Work with Work of other trades.
 - 2. Provide materials and accessories in timely manner so as not to delay Work.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include product specifications and manufacturer's written installation instructions.
- B. Shop Drawings: Show installation details for interface with other work.
- C. Samples
- D. Material Certificates: For each type of bentonite waterproofing, signed by manufacturers.
 - 1. Submit membrane manufacturer's certification that proposed materials, details and systems as indicated and specified fully comply with manufacturer's details and specifications.
 - 2. If any portion of Contract Documents does not conform to manufacturer's standard recommendations, submit notification of portions of design that are at variance with manufacturer's specifications and which would interfere with issuance of warranty.
- E. Field quality-control test reports.

- F. Qualification Data: Submit installer qualifications verifying years of experience and current approval of waterproofing manufacturer; include list of completed projects having similar scope of work identified by name, location, date, reference names and phone numbers.
- G. Inspection Reports: Submit copy of manufacturer's technical representative's field inspection reports.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for bentonite waterproofing.
- I. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain primary waterproofing materials from single manufacturer with not less than 5 years documented, successful experience in supplying principal materials for waterproofing work.
- B. Installer Qualifications:
 - 1. Not less than 5 years documented, successful experience with work comparable to Work of this Project; approved by manufacturer of waterproofing. Such approval shall be current as of the date of bid of this Project.
 - 2. Installer must maintain full-time supervisor on job site during times that Work is in progress. Supervisor must have minimum of 5 years experience in work similar in nature and scope to Work of this Project.
- C. Manufacturer's Inspections:
 - 1. Provide inspections by manufacturer's technical representative prior to, during and at completion of installation.
 - 2. Contractor shall be responsible for carrying out recommendations of manufacturer's representative.
 - 3. Provide written reports of inspection.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle and protect products in accordance with manufacturer's instructions.
- B. Deliver materials in manufacturer's unopened containers, fully identified with brand, type, grade, class and all other qualifying information.
- C. Take necessary precautions to keep products clean, dry and free of damage.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit waterproofing to be installed according to manufacturers' written instructions and warranty requirements.
 - 1. Do not apply waterproofing materials to surfaces where ice or frost is visible. Do not apply waterproofing materials in areas with standing water.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of waterproofing system that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Water penetrating the building or structure resulting from substrate cracking of up to 1/8 inch (3 mm).
 - b. Deteriorated or displaced waterproofing materials.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. Super 200 by American Permaquik, Inc.
 3. Super Seal by Conproco Corp.
 4. Penetron Addmix by ICS Penetron International Ltd.
 5. Vandex Super by Vandex International Ltd.
 6. Xypex by Xypex Chemical Corp.

2.2 MATERIALS, GENERAL

- A. Waterproofing Material:
1. Dry powder compound consisting of portland cement, very fine silica sand and proprietary chemicals.
 2. Physical properties:
 - a. Permeability: 0 for water at 33 feet when tested according to CE CRD-C 48.
 - b. Compressive strength: Not less than 3000 psi when tested according to ASTM C109.
- B. Water: Clean, clear, nonalkaline and free of salts and other harmful elements; potable.

2.3 INSTALLATION ACCESSORIES

- A. Patching Compound:
1. Cementitious waterproofing and repair mortar for filling and patching tie holes, honeycombs, reveals, and other imperfections.
 2. Physical properties:
 - a. Compressive strength: 7600 psi at 28 days when tested according to ASTM C109.

- b. Flexural strength: 710 psi at 28 days when tested according to ASTM C348.
- c. Shrinkage: Minus 0.093% at 28 days and plus 0.073% at 90 days when tested according to ASTM C596.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate preparations affecting performance of waterproofing.
 - 1. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify that substrate is complete and that all work that will penetrate waterproofing is complete and rigidly installed. Verify locations of waterproofing termination.

3.2 PREPARATION

- A. Coordinate work in the vicinity of waterproofing to ensure proper conditions for installing the waterproofing system and to prevent damage to waterproofing after installation.
- B. Formed Concrete Surfaces: Remove fins and projections. Fill voids, rock pockets, form-tie holes, and other defects with bentonite mastic or cementitious patching material according to manufacturer's written instructions.
- C. Horizontal Concrete Surfaces: Remove debris, standing water, oily substances, mud, and similar substances that could impair the bonding ability of concrete or the effectiveness of waterproofing. Fill voids, cracks greater than 1/8 inch (3 mm), honeycomb areas, and other defects with bentonite mastic or cementitious patching material according to manufacturer's written instructions.
- D. Protect adjacent surfaces not designated to receive waterproofing.
- E. Substrate Preparation:
 - 1. Follow manufacturer's instructions to clean and prepare surfaces and seal cracks and joints.
 - 2. Remove concrete fins and projections.
 - 3. Clean surfaces to receive waterproofing by high pressure water jet, light sand blasting, scarifying or other methods recommended by waterproofing manufacturer to produce surfaces suitable for application of waterproofing.
 - 4. Patch visible cracks exceeding 0.01 inch in width, construction joints, voids, holes, spalled areas, honeycombed areas and areas where coarse aggregate is visible.
 - a. Rout out area to sound concrete, with minimum 3/4 inch depth.
 - b. Apply slurry coating of waterproofing material to surfaces of routed areas, at rate recommended by manufacturer.
 - c. Fill routed areas with patching compound in layers of 2 inch maximum thickness, until flush with surrounding substrate. Apply subsequent layers only after previous layer has reached initial set.
- F. Application of coves at junction of slabs and vertical surfaces:

1. Apply slurry coating of waterproofing material minimum 6 inches wide, at rate recommended by manufacturer.
 2. Form cove with patching compound.
- G. Prior to application of waterproofing, rinse surfaces thoroughly with water. Surfaces shall be moist but not wet when waterproofing system is applied.

3.3 INSTALLATION, GENERAL

- A. Mix waterproofing material in proportions recommended by manufacturer.
- B. Apply waterproofing in two coats, in accordance with waterproofing manufacturer's instructions and recommended rates.
- C. Base Coat:
1. Apply base coating in slurry consistency at uniform rate.
 2. Apply using stiff masonry brush.
- D. Finish Coat:
1. Apply finish coat after base coat has reached initial set but is still green.
 2. Apply finish slurry coating at same rate as base coat.
 3. Apply so that final brush strokes leave parallel, uniform texture.
- E. Curing:
1. Protect surfaces from rain, frost and drying out.
 2. Keep surfaces damp for minimum of 5 days.
 3. Use moist curing methods recommended by manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Inspection: Arrange for manufacturer's representative to inspect completed installation and provide written report that installation complies with manufacturer's written instructions.
1. Remove and replace applications of waterproofing where inspection indicates that it does not comply with specified requirements.
- B. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 071660

SECTION 071700 - BENTONITE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes geotextile/bentonite sheet waterproofing.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for forms and for concrete placement.
 - 2. Division 07 sheet waterproofing Sections for flexible flashing that may be part of adjoining waterproofing work.
 - 3. Division 07 Section "Joint Sealants" for elastomeric sealants.
 - 4. Division 31 Section "Earth Moving" for excavating and backfilling.
 - 5. Division 33 Section "Subdrainage" for subsurface drainage systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide waterproofing that prevents the passage of water according to the following criteria:
 - 1. Permeability: 5 by 10^{-10} cm/sec. according to ASTM D 5084.
 - 2. Grab Tensile Strength: 95 lbf (422 N) according to ASTM D 4632.
 - 3. Elongation: 75 percent according to ASTM D 4632.
 - 4. Puncture Resistance: 120 psi (828 kPa) according to ASTM D 4833.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include product specifications and manufacturer's written installation instructions.
- B. Shop Drawings: Show installation details for interface with other work.
- C. Samples: For each of the following products, in sizes indicated:
 - 1. Waterproofing: 6 inches (150 mm) square.
 - 2. Flexible Flashing Membrane: 6 inches (150 mm) square.
 - 3. Protection Board: 6 inches (150 mm) square.
 - 4. Drainage Mat: 6 inches (150 mm) square.
- D. Material Certificates: For each type of bentonite waterproofing, signed by manufacturers.
- E. Field quality-control test reports.

- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for bentonite waterproofing.
- G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain bentonite waterproofing system through one source from a single manufacturer. Obtain accessory products used with bentonite waterproofing from sources acceptable to bentonite waterproofing manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original unopened and undamaged containers.
- B. Store materials in a dry, well-ventilated space.
- C. Remove and replace bentonite materials that have been prematurely exposed to moisture.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit bentonite waterproofing to be installed according to manufacturers' written instructions and warranty requirements.
 - 1. Do not apply waterproofing materials to surfaces where ice or frost is visible. Do not apply bentonite waterproofing materials in areas with standing water.
 - 2. Placing of bentonite clay products in panel or composite form on damp surfaces is allowed if approved in writing by manufacturer.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of bentonite waterproofing system that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Water penetrating the building or structure resulting from substrate cracking of up to 1/8 inch (3 mm).
 - b. Deteriorated or displaced waterproofing materials.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Granular Bentonite: Sodium bentonite clay containing a minimum of 90 percent montmorillonite (hydrated aluminum silicate), with a minimum of 90 percent passing a No. 20 (0.85-mm) sieve.
- B. Bentonite Mastic: Trowelable consistency, bentonite compound, specifically formulated for application at joints and penetrations.
- C. Granular Bentonite Tubes: Manufacturer's standard 2-inch- (50-mm-) diameter, water-soluble tube containing approximately 1.5 lb/ft. (2.2 kg/m) of bentonite; hermetically sealed; designed specifically for placing on wall footings at line of joint with exterior base of wall.
- D. Preformed Waterstop: Flexible strip of bentonite waterproofing compound in cartridge or coil form; designed specifically for vertical and horizontal joints in concrete construction.

2.3 GEOTEXTILE/BENTONITE SHEETS

- A. Geotextile/Bentonite Waterproofing: Minimum of 1.0 lb/sq. ft. (5 kg/sq. m) of bentonite clay granules between 2 layers of geotextile polypropylene fabric, one woven and one nonwoven, needlepunched and heat fused together.
 - 1. Products:
 - a. CETCO; Voltex.
 - b. Carlisle Coatings & Waterproofing Inc.; CCW Clay Mat.
 - c. MiraDRI Moisture Protection Products, TC MiraDRI; MiraCLAY.

2.4 INSTALLATION ACCESSORIES

- A. Protection Board: Provide products recommended in writing by waterproofing manufacturer to suit Project. Available types include the following:
 - 1. Semirigid board with mineral-reinforced asphaltic core laminated between an asphalt-saturated felt liner on one side and a weather-coated, glass-mat liner covered with a bond-breaking film on the other.
 - a. Thickness: 1/8 inch (3 mm).
- B. Molded-Sheet Drainage Panels: Prefabricated, composite drainage panels, manufactured with a permeable geotextile facing laminated to a molded-plastic, three-dimensional sheet drainage core.
 - 1. Products:

- a. CETCO; Aquadrain.
 - b. MiraDRI Moisture Protection Products, TC MiraDRI; MiraDRAIN 8000.
- C. Termination Bar: Extruded-aluminum or formed-stainless-steel bars with upper flange to receive sealant.
 - D. Plastic Protection Sheets: Polyethylene sheeting complying with ASTM D 4397; thickness as recommended in writing by waterproofing manufacturer to suit application but at least 6 mils (0.15 mm) thick.
 - E. Fasteners: Case-hardened nails or hardened-steel, powder-actuated fasteners. Depending on manufacturer's written requirements, provide 1/2- or 1-inch- (13- or 25-mm-) diameter washers under fastener heads.
 - F. Sealants: As recommended in writing by waterproofing manufacturer. Comply with requirements specified in Division 07 Section "Joint Sealants."
 - G. Tapes: As recommended in writing by waterproofing manufacturer for joints between sheets or panels.
 - H. Adhesive: Water-based adhesive used to secure membrane to both vertical and horizontal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate preparations affecting performance of bentonite waterproofing.
 - 1. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify that substrate is complete and that all work that will penetrate waterproofing is complete and rigidly installed. Verify locations of waterproofing termination.

3.2 PREPARATION

- A. Coordinate work in the vicinity of waterproofing to ensure proper conditions for installing the waterproofing system and to prevent damage to waterproofing after installation.
- B. Formed Concrete Surfaces: Remove fins and projections. Fill voids, rock pockets, form-tie holes, and other defects with bentonite mastic or cementitious patching material according to manufacturer's written instructions.
- C. Horizontal Concrete Surfaces: Remove debris, standing water, oily substances, mud, and similar substances that could impair the bonding ability of concrete or the effectiveness of waterproofing. Fill voids, cracks greater than 1/8 inch (3 mm), honeycomb areas, and other defects with bentonite mastic or cementitious patching material according to manufacturer's written instructions.

3.3 INSTALLATION, GENERAL

- A. Install waterproofing and accessories according to manufacturer's written instructions, standard details, and recommended practices.
 - 1. Apply linear joint-sealing tubes, bentonite mastic, or both at changes of plane, construction joints in substrate, projections, and penetrations.
 - 2. Apply granular bentonite around penetrations in horizontal surfaces according to manufacturer's written instructions.
- B. Static Construction Joints: Protect construction joints with bentonite preformed waterstop flexible strips. Either place concrete directly over flexible strips or press strips into preformed cavities. Comply with manufacturer's written instructions where joint waterproofing is not otherwise indicated.
- C. Apply granular bentonite continuously at base of wall waterproofing (on footing, against wall) according to manufacturer's written instructions.
- D. Protect waterproofing from damage and wetting before and during subsequent construction operations. Repair punctures, tears, and cuts according to manufacturer's written instructions.
- E. Apply sealants to comply with requirements specified in Division 07 Section "Joint Sealants" and with manufacturer's written instructions.

3.4 GEOTEXTILE/BENTONITE SHEET INSTALLATION

- A. General: Install a continuous layer of waterproofing sheets with woven geotextile side directly against concrete to be waterproofed. Lap ends and edges a minimum of 4 inches (100 mm) on horizontal and vertical substrates. Stagger end joints between sheets a minimum of 24 inches (600 mm). Fasten seams by stapling to adjacent sheet or nailing to substrate.
- B. Below Structural Slabs-on-Grade: Place waterproofing sheets on compacted substrate with woven geotextile side up with ends and edges lapped and stapled.
 - 1. Install a layer of waterproofing sheets under footings, grade beams, and pile caps; or continue waterproofing through key joints between footings and foundation walls, and extend a minimum of 8 inches (200 mm) up or beyond perimeter slab forms.
- C. Concrete Walls: Starting at bottom of wall, apply waterproofing sheets horizontally with primary backing side against wall. Secure with powder-actuated fasteners or case-hardened, steel-cap masonry nails; spaced according to manufacturer's written instructions. Extend to bottom of footing, grade beam, or wall and secure as recommended in writing by manufacturer.
 - 1. Termination at Grade: Extend waterproofing sheets to within 2 inches (50 mm) of finish grade, unless otherwise indicated. Secure top edge with termination bar. Apply sealant to top edge of termination bar.

3.5 FIELD QUALITY CONTROL

- A. Inspection: Arrange for manufacturer's representative to inspect completed installation and provide written report that installation complies with manufacturer's written instructions.

1. Remove and replace applications of bentonite waterproofing where inspection indicates that it does not comply with specified requirements.
- B. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 071700

SECTION 071800 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes traffic coatings and pavement markings for the following applications:
 - 1. Pedestrian traffic.
- B. Related Requirements:
 - 1. Section 033000 "Cast-In-Place Concrete."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including installation instructions.
- B. Shop Drawings: For traffic coatings.
 - 1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions.
- C. Samples for Verification: For each type of exposed finish, prepared on rigid backing.
 - 1. Provide stepped Samples on backing to illustrate buildup of traffic coatings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of traffic coating.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For traffic coatings to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Mockups: Build mockups to set quality standards for materials and execution.
1. Build mockup for each traffic coating and substrate to receive traffic coatings.
 2. Size: 200 sq. ft. (18.5 sq. m) of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F (5 deg C), when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.
- B. Do not install traffic coating until items that penetrate membrane have been installed.
- C. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4.4 deg C) for oil-based materials or 50 deg F (10 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Adhesive or cohesive failures.
 - b. Abrasion or tearing failures.
 - c. Surface crazing or spalling.
 - d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Material Compatibility: Provide primers; base-, intermediate-, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Source Limitations:
 - 1. Obtain traffic coatings from single source from single manufacturer.
 - 2. Obtain primary traffic-coating materials, including primers, from traffic-coating manufacturer. Obtain accessory materials including aggregates, sheet flashings, joint sealants, and substrate repair materials of types and from sources recommended in writing by primary material manufacturer.

2.2 TRAFFIC COATING

- A. Traffic Coating: Manufacturer's standard, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, waterproofing membrane system with integral wearing surface for pedestrian traffic; according to ASTM C 957.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AVM Industries, Inc.: AVM System 680SF
 - b. Euclid Chemical Company (The); an RPM company.: Tammsdeck.
 - c. LymTal International Inc.: Iso-Flex 750U.
 - d. Pecora Corporation: Pecora Deck 8013 HD.
 - e. POLY-CARB, Inc.: Flexodeck II.
 - f. Urethane Polymers International, Inc.: Uradek System #65-S.
- B. Primer: Liquid water or solvent-borne primer recommended for substrate and conditions by traffic-coating manufacturer.
- C. Preparatory and Base Coats: Aromatic urethane.
 - 1. Thicknesses: Minimum dry or wet film thickness as recommended in writing by manufacturer for substrate and service conditions indicated.
- D. Intermediate Coat: Aromatic urethane, Aliphatic urethane or epoxy.
 - 1. Thicknesses: Minimum dry or wet film thickness as recommended in writing by manufacturer for substrate and service conditions indicated, measured excluding aggregate.
 - 2. Aggregate Content: As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated.
- E. Topcoat: Aliphatic urethane or Aromatic urethane with UV inhibitors or epoxy.
 - 1. Thicknesses: Minimum dry or wet film thickness as recommended in writing by manufacturer for substrate and service conditions indicated.
 - 2. Color: As selected by Architect from manufacturer's full range.

- F. Aggregate: Uniformly graded, washed silicon carbide sand or uniformly graded, washed silica sand of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.

2.3 ACCESSORY MATERIALS

- A. Joint Sealants: As specified in Section 079200 "Interior Joint Sealants."
- B. Sheet Flashing: Nonstaining sheet material recommended in writing by traffic-coating manufacturer.
 - 1. Thickness: Minimum 60 mils (1.5 mm).
- C. Adhesive: Contact adhesive recommended in writing by traffic-coating manufacturer.
- D. Reinforcing Strip: Fiberglass mesh recommended in writing by traffic-coating manufacturer.

2.4 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.
 - 1. Color: As selected by Owner from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of traffic-coating work.
- B. Verify that substrates are visibly dry and free of moisture.
 - 1. Test for moisture content by method recommended in writing by traffic-coating manufacturer.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of traffic-coating work.
- D. Proceed with installation only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
 - 1. Begin coating application only after minimum concrete-curing and -drying period recommended in writing by traffic-coating manufacturer has passed and after substrates are dry.
 - 2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. General: Before applying traffic coatings, clean and prepare substrates according to ASTM C 1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer.
- B. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.
- C. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.
- D. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D 4259. Do not acid etch.
 - 1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
 - 2. Remove concrete fins, ridges, and other projections.
 - 3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
 - 4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

3.3 TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written instructions.
- B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.
- C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.
- D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.
- B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

3.5 TRAFFIC-COATING APPLICATION

- A. Apply traffic coating according to ASTM C 1127 and manufacturer's written instructions.

- B. Apply number of coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.
- C. Start traffic-coating application in presence of manufacturer's technical representative.
- D. Verify that wet film thickness of each coat complies with requirements every 100 sq. ft. (9 sq. m).
- E. Uniformly broadcast aggregate on coats specified to receive aggregate. Embed aggregate according to manufacturer's written instructions. After coat dries, sweep away excess aggregate.
- F. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.
- G. Cure traffic coatings. Prevent contamination and damage during application and curing stages.

3.6 PAVEMENT MARKINGS

- A. Do not apply pavement-marking paint for striping and other markings until layout, colors, and placement have been verified with Architect and traffic coating has cured.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply pavement-marking paint with mechanical equipment to produce markings of dimensions indicated with uniform straight edges. Apply at manufacturer's recommended rates for a 15-mil- (0.4-mm-) minimum, wet film thickness.
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform the following field tests and inspections:
 - 1. Materials Testing:
 - a. Samples of material delivered to Project site shall be taken, identified, sealed, and certified in presence of Owner and Contractor.
 - b. Testing agency shall perform tests for characteristics specified, using applicable referenced testing procedures.
 - c. Testing agency shall verify thickness of coatings during traffic-coating application for each 600 sq. ft. (56 sq. m) of installed traffic coating or part thereof.
 - 2. If test results show traffic coating does not comply with requirements, remove and replace or repair the membrane as recommended in writing by traffic-coating manufacturer and make further repairs after retesting until traffic-coating installation passes.
- B. Final Traffic-Coating Inspection: Arrange for traffic-coating manufacturer's technical personnel to inspect membrane installation on completion.

1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.8 PROTECTING AND CLEANING

- A. Protect traffic coatings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071800

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Mineral-wool board insulation.
2. Glass-fiber blanket insulation.
3. Mineral-wool blanket insulation.

- B. Related Sections:

1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
2. Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for insulation specified as part of roofing construction.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 MINERAL-WOOL BOARD INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Roxul Inc.
 2. Thermafiber.
 3. Industrial Insulation Group, LLC.
 4. Rockwool Manufacturing Co.
- B. Unfaced, Mineral-Wool Board Insulation: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), Type II, thermal resistivity of 4.16 deg F x h x sq. ft./Btu x in. at 75 deg F (28.8 K x m/W at 24 deg C).
 2. Nominal density of 8 lb/cu. ft. (128 kg/cu. m), Type III, thermal resistivity of 4.35 deg F x h x sq. ft./Btu x in. at 75 deg F (30.2 K x m/W at 24 deg C).
 3. Fiber Color: Darkened.
- C. Unfaced, Mineral-Wool Drain Board Insulation for below grade applications: ASTM C 1104 with moisture sorption of less than .04%; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Nominal density of 6 lb/cu. ft., Type II, thermal resistivity of 4.16 deg F x h x sq. ft./Btu x in. at 75 deg F.
 2. Nominal density of 8 lb/cu. ft., Type III, thermal resistivity of 4.35 deg F x h x sq. ft./Btu x in. at 75 deg F.
 3. Fiber Color: Darkened.

2.2 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CertainTeed Corporation.
 2. Johns Manville.
 3. Knauf Insulation.
 4. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.3 MINERAL-WOOL BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Roxul Inc.
 2. Thermafiber.

- B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.4 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
 - b. Gemco; Spindle Type.
 - 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch diameter; length to suit depth of insulation indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical surfaces, set insulation units according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

3.6 INSTALLATION OF CURTAIN-WALL INSULATION

- A. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.
 - 1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
 - 2. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.

3.7 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes fluid-applied, vapor-retarding membrane air barriers.
- B. Related Sections include the following:
 - 1. Division 06 Section "Sheathing" for wall sheathings, wall sheathing joint-and-penetration treatments, building paper, and building wraps.
 - 2. Division 07 Section "Thermal Insulation" for foam-plastic board insulation.
 - 3. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal flashings.
 - 4. Division 07 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 DEFINITIONS

- A. ABAA: Air Barrier Association of America.
- B. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- C. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity
- D. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air Barrier Assembly Air Leakage: Not to exceed 0.01 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft.; ASTM E 283.

1.5 SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.
- B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 1. Include details of interfaces with other materials that form part of air barrier.
 - 2. Include details of mockups.
- C. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.
- D. Qualification Data: For Applicator.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance and that is an ABAA-licensed contractor, employs certified and registered installers, and complies with ABAA's Quality Assurance Program.
- B. Mockups: Before beginning installation of air barrier, Build integrated mockups of exterior wall assembly as shown on Drawings , incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.
 - 1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
 - 2. Include junction with roofing membrane, building corner condition,.
 - 3. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Contractor will engage a qualified testing agency to perform preconstruction testing on field mockups.
- B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Store rolls according to manufacturer's written instructions.
- D. Protect stored materials from direct sunlight.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER

- A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: water based synthetic polymer membrane.
 - 1. Available Products: Subject to compliance with requirements, but not limited to the basis-of-design: Henry Company, Air Bloc 32MR
 - 2. Physical and Performance Properties:
 - a. Membrane Air Permeance: Not to exceed 0.00012 cfm x sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 283.
 - b. Membrane Vapor Permeance: Not to exceed 0.08 perm; ASTM E 96.
- B. Cold Weather Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, modified bituminous.
 - 1. Available Products: Subject to compliance with requirements, but not limited to the basis-of-design: Henry Company, Air Bloc 06WB.
 - 2. Physical and Performance Properties:
 - a. Membrane Air Permeance: Not to exceed 0.000035cfm x sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 283.
 - b. Membrane Vapor Permeance: Not to exceed 0.02 perm; ASTM E 96.

2.2 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

- B. Primer: Liquid primer recommended for substrate by manufacturer of air barrier material for self adhering transition material.
- C. Counterflashing Strip: Modified bituminous, 40-mil- thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil- thick, crosslaminated polyethylene film with release liner backing.
- D. Butyl Strip: Vapor-retarding, 30- to 40-mil- thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.
- E. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.
- F. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- G. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- H. Adhesive-Coated Transition Strip: Vapor-permeable, 17-mil- thick, self-adhering strip consisting of an adhesive coating over a permeable laminate with a permeance of 37 perms.
- I. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
- J. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
 - 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 4. Verify that masonry joints are flush and completely filled with mortar.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

- A. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

- A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using auxiliary materials approved by air barrier manufacturer.
- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

- E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply adhesive-coated transition strip, elastomeric flashing sheet so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
 - 1. Transition Strip: Roll firmly to enhance adhesion.
 - 2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
 - 3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.
- G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.
- H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- I. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, counterflashing strip.
- J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 AIR BARRIER MEMBRANE INSTALLATION

- A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.
- B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.
- C. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- D. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
 - 1. Vapor-Retarding Membrane Air Barrier: 120-mil wet film thickness.

- E. Apply strip and transition strip over cured air membrane overlapping 3 inches onto each surface according to air barrier manufacturer's written instructions.
- F. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 - 1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes, and to the minimum specified wet film thickness..
 - 2. Continuous structural support of air barrier system has been provided.
 - 3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
 - 4. Site conditions for application temperature and dryness of substrates have been maintained.
 - 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 6. Surfaces have been primed, if applicable.
 - 7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 - 8. Termination mastic has been applied on cut edges.
 - 9. Strips and transition strips have been firmly adhered to substrate.
 - 10. Compatible materials have been used.
 - 11. Transitions at changes in direction and structural support at gaps have been provided.
 - 12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
 - 13. All penetrations have been sealed.
- C. Tests: As determined by Contractor's testing agency from among the following tests:
 - 1. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to ASTM E 783.
 - 2. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.
- D. Air barriers will be considered defective if they do not pass tests and inspections.
 - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 - 2. Remove and replace deficient air-barrier components for retesting as specified above.

- E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

- A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 30 days.
 - 2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 074243 - COMPOSITE WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes metal-faced composite wall panels.
- B. Related Sections:
 - 1. Section 084413 "Glazed Aluminum Curtain Walls" for insulated metal spandrel panels in curtain wall assemblies.

1.3 DEFINITION

- A. Metal-Faced Composite Wall Panel Assembly: Metal-faced composite wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weather-tight wall system.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal-faced composite wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Design metal-faced composite wall panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. () of wall area when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft.
- D. Water Penetration Under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- E. Structural Performance: Provide metal-faced composite wall panel assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
 - 1. Wind Loads: Determine loads based on the following minimum design wind

pressures:

- a. Uniform pressure of 30 lbf/sq. ft., acting inward or outward.
 - b. Uniform pressure as indicated on Drawings.
2. Deflection Limits: Metal-faced composite wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/175 of the span at the perimeter and 1/60 of the span anywhere in the panel.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal-faced composite wall panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal-faced composite wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish among factory-, shop-, and field-assembled work.
1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Anchorage systems.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Metal-Faced Composite Wall Panels: Minimum 12 x 12 inches. Include fasteners, closures, and other metal-faced composite wall panel accessories.
 - a. Composite Panels: Include four-way joint.
 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 3. Accessories: 12-inch-long Samples for each type of accessory.
 4. Exposed Gaskets: 12 inches long.
 5. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2-inch- wide joints formed between two 6-inch-long strips of material matching the appearance of metal-faced composite wall panels adjacent to joint sealants.
- D. Delegated-Design Submittal: For metal-faced composite wall panel assembly indicated to comply with performance requirements and design criteria, including

analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Exterior elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Wall panels and attachments.
 - 2. Girts.
 - 3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
 - 4. Penetrations of wall by pipes and utilities.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- C. Field quality-control reports.
- D. Warranties: Samples of special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal wall panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Source Limitations: Obtain each type of metal-faced composite wall panel from single source from single manufacturer.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall panel, including soffit, as shown on Drawings; supports, attachments, and accessories.
 - a. Include four-way joint for metal-faced composite wall panels.
 - 2. Conduct water-spray test of mockup of metal-faced composite wall panel assembly, testing for water penetration according to AAMA 501.2.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Contractor, Architect, Contractor's insurer if applicable, testing and inspecting agency representative, metal-faced composite wall panel Installer, metal-faced composite wall panel manufacturer's representative,

structural-support Installer, and installers whose work interfaces with or affects metal-faced composite wall panels including installers of doors, windows, and louvers.

2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal-faced composite wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal-faced composite wall panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal-faced composite wall panel assembly during and after installation.
8. Review wall panel observation and repair procedures after metal-faced composite wall panel installation.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal-faced composite wall panels, and other manufactured items so as not to be damaged or deformed. Package metal-faced composite wall panels for protection during transportation and handling.
- B. Unload, store, and erect metal-faced composite wall panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Store metal-faced composite wall panels vertically, covered with suitable weathertight and ventilated covering. Store metal-faced composite wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal-faced composite wall panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg F.
- D. Retain strippable protective covering on metal-faced composite wall panel for period of panel installation.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal-faced composite wall panels to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal-faced composite wall panel fabrication and indicate measurements on Shop Drawings.

1.11 COORDINATION

- A. Coordinate metal-faced composite wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal-faced composite wall panel assemblies that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal-faced composite wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

- A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
1. Surface: Smooth, flat finish.
 2. Exposed Coil-Coated Finishes:
 - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Mica Fluoropolymer: AAMA 620. 2-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Panel Sealants:

1. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal-faced composite wall panels and remain weathertight; and as recommended in writing by panel manufacturer.

2.2 MISCELLANEOUS METAL FRAMING

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G60 hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.
- B. Subgirts: Manufacturer's standard C- or Z-shaped sections 0.064-inch nominal thickness.
- C. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates. Provide EPSM, PVC, or neoprene sealing washers.

2.3 MISCELLANEOUS MATERIALS

- A. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated.
- B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide EPDM, PVC, or neoprene sealing washers.

2.4 METAL-FACED COMPOSITE WALL PANELS

- A. General: Provide factory-formed and -assembled, metal-faced composite wall panels fabricated from two metal facings bonded, using no glues or adhesives, to solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight system.
 1. Products: Subject to compliance with requirements, provide composite wall panels by one of the following:
 - a. Alcan Composites USA Inc.; Alucobond.
 - b. ALPOLIC, Division of Mitsubishi Chemical America, Inc.; ALPOLIC.
 - c. CENTRIA Architectural Systems; Formabond Wall System.
 - d. Fairview Architectural; VITRABOND.
- B. Aluminum-Faced Composite Wall Panels - Drawing Designation - MP1:
 1. Formed with 0.020-inch- thick, coil-coated aluminum sheet facings.
 2. Panel Thickness: 4mm.
 3. Core: Standard.
 4. Self-Ignition Temperature: 650 degrees F or greater when tested in accordance with ASTM D1929.

5. Combustibility: Class CC1 (1" or less at nominal thickness of specified panel) when tested in accordance with ASTM D63.
6. Exterior Finish: Mica fluoropolymer.
 - a. Color: To match color used at Science Center and Science East: Titanium C-3100-DXLE.

C. Aluminum-Faced Composite Wall Panels: Drawing Designation - MP2

1. Formed with 0.020-inch thick, coil coated aluminum sheet facings.
2. Panel Thickness: 4mm.
3. Core: Standard.
4. Self-Ignition Temperature: 650 degrees F or greater when tested in accordance with ASTM D1929.
5. Combustibility: Class CC1 (1" or less at nominal thickness of specified panel) when tested in accordance with ASTM D63. Exterior Finish: 2-coat fluoropolymer.
 - a. Color: To match color used at Science Center and Science East: Birch B2000-D

D. Attachment System Components: Formed from material compatible with panel facing.

1. Include manufacturer's standard perimeter extrusions with integral weather stripping panel clips and anchor channels.

2.5 ACCESSORIES

- A. Wall Panel Accessories: Provide components required for a complete metal-faced composite wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal-faced composite wall panels unless otherwise indicated.
- B. Flashing and Trim: Formed from 0.018-inch- minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal-faced composite wall panels.

2.6 FABRICATION

- A. General: Fabricate and finish metal-faced composite wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal-faced composite wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

- C. Metal-Faced Composite Wall Panels: Factory form panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.
1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
 2. Fabricate panels with sharply cut edges, with no displacement of face sheets or protrusion of core material.
 3. Fabricate panels with panel stiffeners, as required to comply with deflection limits, attached to back of panels with structural silicone sealant or bond tape.
 4. Dimensional Tolerances:
 - a. Panel Bow: 0.8 percent maximum of panel length or width.
 - b. Squareness: 0.25 inch maximum.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal-faced composite wall panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal-faced composite wall panel manufacturer for application, but not less than thickness of metal being secured.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal-faced composite wall panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal-faced composite wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal-faced composite wall panel manufacturer.
 - 3. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal-faced composite wall panels to verify actual locations of penetrations relative to seam locations of panels before panel installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal-faced composite wall panel manufacturer's written instructions.

3.3 METAL-FACED COMPOSITE WALL PANEL INSTALLATION

- A. General: Install metal-faced composite wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Commence metal-faced composite wall panel installation and install minimum of 300 sq. ft. () in presence of factory-authorized representative.
 - 2. Shim or otherwise plumb substrates receiving metal-faced composite wall panels.
 - 3. Flash and seal metal-faced composite wall panels at perimeter of all openings. Do not begin installation until weather barrier and flashings that will be concealed by panels are installed.
 - 4. Install flashing and trim as metal-faced composite wall panel work proceeds.
 - 5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.

6. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners:
1. Aluminum Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal-faced composite wall panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal-faced composite wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.
1. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- E. Attachment System Installation, General: Install attachment system required to support metal-faced composite wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
 2. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.
- F. Track-Support Installation: Provide manufacturer's standard horizontal and vertical tracks that provide support and complete secondary drainage system, draining to the exterior at horizontal joints. Install support system at locations, spacings, and with fasteners recommended by manufacturer. Attach panels to wall by interlocking tracks with perimeter extrusions attached to wall panels. Fully engage integral gaskets and leave horizontal and vertical joints with open reveal.
1. Attach routed-and-turned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
 2. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
 3. Do not apply sealants to joints unless otherwise indicated on Drawings.
- G. Drained/Back-Ventilated Installation: Provide manufacturer's standard Drained/Back-Ventilated system with vertical channel that provides support and complete secondary drainage system, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach wall panels by engaging horizontal support pins into notches in vertical channels and into flanges of wall panels. Leave horizontal and vertical joints with open reveal.
1. Do Not apply sealants to Joints unless otherwise noted on Drawings.

3.4 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal-faced composite wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet ()with no joints allowed within 24 inches ()of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch ()deep, filled with mastic sealant (concealed within joints).

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal-faced composite wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated and within 1/8-inch ()offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections to verify that the Air barrier has not been compromised by the installation of the composite wall panel framing.
- B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 - 1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Continuous structural support of air barrier system has been provided.
 - 3. Site conditions for application temperature and dryness of substrates have been maintained.
 - 4. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 5. Surfaces have been primed, if applicable.
 - 6. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.

7. Termination mastic has been applied on cut edges.
 8. Strips and transition strips have been firmly adhered to substrate.
 9. Compatible materials have been used.
 10. Transitions at changes in direction and structural support at gaps have been provided.
 11. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
 12. All penetrations have been sealed.
- C. Tests: As determined by Contractor's testing agency from among the following tests:
1. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to ASTM E 783.
- D. Air barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional air-barrier material, according to manufacturer's written instructions.
- E. Prepare test and inspection reports.

3.7 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal-faced composite wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal-faced composite wall panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.
- B. After metal-faced composite wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal-faced composite wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074243

SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS
MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Substrate Board.
2. Roofing Insulation.
3. Insulation Cover Board.
4. SBS Self adhered Base Sheet.
5. SBS Base Inner Ply Sheet.
6. SBS Cap Sheet.
7. Walkway Pads.
8. Concrete Roof Pavers and Pedestals.

B. Related Sections:

1. Division 06 Section "Rough Carpentry" for wood blocking, curbs, cants and nailers.
2. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings and counter-flashings.
3. Division 07 Section "Roof Accessories".
4. Division 07 Section "Exterior Expansion Control.
5. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
6. Division 22 Section "Commercial Plumbing Fixtures and Trim" for roof drains.

1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

- B. Material Compatibility: Provide roofing materials that are compatible with one another

under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

- C. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
 - 1. Fire/Windstorm Classification: Class 1A-90.
 - 2. Hail Resistance Rating: MH.
- D. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
- E. Energy Performance: Provide roofing system with initial Solar Reflectance not less than 0.70 and Thermal Emittance not less than 0.75 when tested according to Cool Roof Rating Council's CRRC-1.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes and heights of insulation.
 - 3. Crickets, saddles, and tapered edge strips, including slopes.
 - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products:
 - 1. Sheet roofing materials, including base-ply sheet flashing backer sheet membrane cap sheet and flashing sheet, of color specified.
 - 2. Roof insulation.
 - 3. 3 lb of aggregate surfacing material in gradation and color indicated.
 - 4. Walkway pads or rolls.
 - 5. Six insulation fasteners of each type, length, and finish.
 - 6. Roof paver, full sized, in each color and texture required.
 - 7. Paver supports and accessories.

1.6 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system and is eligible to receive the standard roofing manufacturer's warranty.
- B. Manufacturer Certificates: Signed by roofing system manufacturer certifying that the

roofing system complies with requirements specified in the "Performance Requirements" Article. Upon request, submit evidence of complying with requirements.

- C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- E. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.
- F. Warranties: Sample of special warranties.
- G. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roof installation.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is FM Approvals approved for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including roof insulation for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. Fire Test Response Characteristics: Provide roofing materials with the fire test response characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire Test Exposure: Class-A; complying with ASTM-E-108, for application and slopes indicated.
 - 2. Fire Resistance Ratings: ASTM-E-119, for fire resistance rated roof assemblies of which roofing materials are a part.
- E. Pre-installation Conference: Before installing roofing system, conduct conference at Project site to comply with requirements of Division-1 Section "Project Meetings." Notify participants at least 5 working days before conference.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary

limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, fasteners, substrate board, roofing accessories, roof pavers and other components of membrane roofing system.
 2. Warranty Period: No Dollar Limit 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer's Basis of Design: Firestone Building Products Company, LLC, SBS 3 ply Modified Bitumen, or one of the following approved manufacturers, subject to compliance with requirements:
1. SBS Modified Bituminous Roofing System:
 - a. Siplast, Inc.
 - b. TAMKO Building Products, Inc.
 2. Polyisocyanurate Board Insulation:
 - a. Firestone Building Products
 - b. Hunter Insulation Corp
 - c. or Approved Equal

2.2 SBS-MODIFIED BITUMINOUS-SHEETS

- A. SBS Modified Bituminous Self Adhered Base Sheet: SBS modified, self adhesive asphalt blend reinforced with a 1.8 lb/100ft² (90 grams/m²) glass fiber mat and coated with a fine mineral release agent on the top surface and an opaque release film on the bottom surface; suitable for application method specified; manufacturer's standard thickness and weight; for use and of reinforcing type as follows:
1. Use: Base ply of 3 ply modified bituminous membrane roofing system.
 2. Reinforcing: Glass fiber mat.
- B. SBS Modified Bituminous Base Sheet: SBS modified asphalt sheet, smooth surfaced, dusted with fine parting agent on both sides; suitable for application method specified; manufacturer's standard thickness and weight; for use and of reinforcing type as follows:
1. Use: Inner ply of 3 ply, modified bituminous membrane roofing system and base

2. ply of 2-ply modified base flashing.
 2. Reinforcing: Glass yarn reinforced polyester mat.
- C. SBS FR-Modified Bituminous Cap Sheet, Mineral Surfaced: SBS modified asphalt sheet, with continuous layer of mineral granules factory applied to top exposed surface; suitable for application method specified; with physical properties and for use with reinforcing type and granule color as follows:
1. Use: Finish ply of 3 ply, modified bituminous membrane roofing and base flashing system.
 2. Reinforcing: Glass yarn reinforced polyester mat.
 3. Granule Color: UltraWhite
- D. Physical Properties: Provide SBS modified bituminous self adhered base sheet materials with the following properties when tested according to ASTM-D-5147:
1. Thickness: 70 mils (2 mm).
 2. Tensile Strength: 70 lbf/in. (12.3 kN/m) at 0-deg-F (minus 18-deg-C) in each direction.
 3. Elongation at Maximum Load: 1 percent minimum at 0-deg-F (minus 18-deg-C) in each direction.
 4. Tear Strength: 35lbf (667 N) minimum.
 5. Low temperature Flexibility: Pass at minus 10-deg-F (minus 23-deg-C).
 6. Compound Stability: Not less than 225-deg-F (107-deg-C).
- E. Physical Properties: Provide SBS Poly Torch Base modified bituminous base sheet materials with the following properties when tested according to ASTM-D-6164 Type I Grade S:
1. Thickness: 120 mils (3.4 mm).
 2. Tensile Strength: 70 lbf/in. (12.3 kN/m) at 0-deg-F (minus 18-deg-C) in each direction.
 3. Elongation at Maximum Load: 1 percent minimum at 0-deg-F (minus 18-deg-C) in each direction.
 4. Tear Strength: 35lbf (667 N) minimum.
 5. Low temperature Flexibility: Pass at minus 10-deg-F (minus 23-deg-C).
 6. Compound Stability: Not less than 225-deg-F (107-deg-C).
- F. Physical Properties: Provide SBS FR Torch modified bituminous cap sheet materials with the following properties when tested according to ASTM-D-6164 Type I Grade G:
1. Thickness: 150 mils (3.8 mm).
 2. Tensile Strength: 70 lbf/in. (12.3 kN/m) at 0-deg-F (minus 18-deg-C) in each direction.
 3. Elongation at Maximum Load: 20 percent minimum at 0-deg-F (minus 18-deg-C) in each direction.
 4. Tear Strength: 55lbf (246 N) minimum.
 5. Low temperature Flexibility: Pass at minus 10-deg-F (minus 23-deg-C).

2.3 AUXILIARY MEMBRANE MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Contact Adhesive: 80 g/L.
 - f. Other Adhesives: 250 g/L.
 - g. Non-membrane Roof Sealants: 300 g/L.
 - h. Sealant Primers for Nonporous Substrates: 250 g/L.
 - i. Sealant Primers for Porous Substrates: 775 g/L.
- B. Asphalt Roofing Cement: ASTM D 4586, SBS modified asbestos free, of consistency required by roofing system manufacturer for application.
- C. Cold-Applied Adhesive: Roofing system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with roofing membrane, base flashings and walkway pads.
- D. Mastic Sealant: Polyisobutylene, plain or modified bitumen; non-hardening, non-migrating, non-skinning, and nondrying.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening base flashings; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- F. Metal Flashing Sheet: As specified in Division 07 Section "Sheet Metal Flashing and Trim."
- G. Wood Nailer Strips: As specified in Division 06 Section "Rough Carpentry."
- H. Cants: Wood fiber board, complying with ASTM C-728.
- I. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve.
 - a.
 - b. Color: UltraWhite
- J. Glass-Fiber Fabric: Woven glass cloth, treated with asphalt; complying with ASTM D-1668, Type-I.
- K. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.
- 2.4 SUBSTRATE BOARDS
- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Georgia-Pacific Corporation; Dens Deck Prime.
 - b. Or approved equal.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 INSULATION MATERIALS

- A. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.
 1. Provide pre-formed, tapered insulation boards as needed for sloping to drains. Fabricate with the following taper:
 - a. $\frac{1}{4}$ inch per 12 inches (1:48).
 - b. As indicated on drawings.
 2. Provide pre-formed saddles, crickets, tapered edge strips and other insulation shapes where indicated for sloping to drains. Fabricate to slopes indicated.
- B. Polyisocyanurate Board Insulation: Rigid, cellular polyisocyanurate thermal Insulation with core formed by using HCFCs as blowing agents complying with ASTM C-1289-02 with and LTTR R-value of 30 and a thickness of 5" minimum, classified by facer type as follows:
 1. Facer Type: Type II, felt or glass-fiber mat facer on both major surfaces.

2.6 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
- B. Fasteners: Roofing system manufacturer's factory-coated steel fasteners and metal plates meeting corrosion-resistance provisions of FM-4470, designed for fastening board insulation to substrate.
- C. Insulation Adhesive: Adhesive shall be roofing systems manufacturer's two-component adhesive specifically formulated to attach roof insulation to substrate or to another insulation layer, tested by manufacturer for required uplift design.
- D. Cover Board: factory primed, glass-fiber faced gypsum sheathing complying with ASTM E-136 and E-84, $\frac{1}{2}$ " thick.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Georgia-Pacific Corporation; Dens Deck Prime.
 - b. Or approved equal.

2.7 ROOF PAVERS

- A. Heavyweight, hydraulically pressed, concrete units, with top edges beveled 3/16 inch, factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C 67; and as follows:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hanover Architectural Products; Architectural Roof and Plaza Paver
 - b. Or approved equal
 2. Size: 24 by 24 inches. Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch in length, height, and thickness.
 3. Weight: 25 lbs/sf.
 4. Compressive Strength: 8,500 psi, minimum; ASTM C 140.
 5. Colors and textures: Tudor finish, color as selected by Architect from manufacturer's full range.
 6. Paver supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of 1/8 to 3/16 inch.

2.8 WALKWAYS

- A. Walkway Pads: Polymer-modified, reconstituted rubber pads with slip-resisting textured surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 1/2 inch thick, minimum.
1. Basis-of-Design: Humane Manufacturing, Inc. Roof-Gard
 2. Pad Size: 36 by 48 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
 2. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
 3. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - a. Test for moisture by pouring 1 pint of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane. Do not proceed with roofing work if test sample foams or can be easily and cleanly stripped after cooling.

4. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
 5. Verify that wood blocking, curbs and nailers are securely anchored to roof deck at roof penetrations and terminations and match the thicknesses of insulation required.
 6. Verify that wood nailer strips are located perpendicular to roof slope and are spaced according to requirements of roofing system manufacturer.
 7. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install modified bituminous membrane roofing system according to roofing system manufacturer's written instructions and applicable recommendations of NRCA/ARMA's "Quality Control Recommendations for Polymer Modified Bitumen Roofing."
 1. Install roofing system according to applicable specification plates of NRCA's "The NRCA Roofing and Waterproofing Manual."
- B. Start installation of modified bituminous membrane roofing in presence of roofing system manufacturer's technical personnel.
- C. Shingling Plies: Install modified bituminous membrane roofing system with ply sheets shingled uniformly to achieve required number of membrane plies throughout. Shingle in direction to shed water.
- D. Cant Strips: Install and secure preformed 45 degree cant strips at junctures of modified bituminous membrane roofing system with vertical surfaces or angle changes greater than 45 degrees.
- E. Cooperate with inspecting and testing agencies engaged or required to perform services for installing modified bituminous membrane roofing system.
- F. Coordinate installing roofing system components so insulation and roofing plies are not exposed to precipitation or left exposed at the end of the workday or when rain is forecast.
 1. Provide cut-offs at end of each day's work to cover exposed ply sheets and insulation with a course of coated felt with joints and edges sealed.
 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.

3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 INSULATION AND SUBSTRATE INSTALLATION

- A. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.
- B. Coordinate installing roofing system components so that insulation is not exposed to precipitation or left exposed at the end of the workday.
- C. Comply with roofing system manufacturer's written instructions for installing roof insulation.
- D. Install tapered insulation under area of roofing to conform to slopes indicated.
- E. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- F. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- G. Trim surface of insulation where necessary at roof drains so completed surface is flush with ring of drain and does not restrict flow of water.
- H. Install insulation with long joints of insulation in continuous straight lines with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6mm) with insulation.
 1. Cut and fit insulation within 1/4 inch (6mm) of nailers, projections, and penetrations.
- I. Metal Deck, Roof type R1: Mechanically attach substrate to steel deck with a common fastener. Adhere poly-iso insulation and gypsum cover board to substrate board with roofing system manufacturer's two-component urethane insulation adhesive. Follow roof system manufacturer's adhesion pattern and standard specifications for specified wind up-lift.
- J. Concrete Deck, Roof type R2: Adhere poly-iso insulation and gypsum cover board to concrete deck with roofing system manufacturer's two-component urethane insulation adhesive. Follow roof system manufacturer's adhesion pattern and standard specifications for specified wind up-lift.
- K. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints a minimum of 6 inches in each direction from joints of insulation below. Loosely butt cover boards together. Tape joints if required by roofing system manufacturer.

3.5 ROOFING MEMBRANE INSTALLATION

- A. General: Install roofing membrane system according to roofing system manufacturer's

written instructions. Extend modified bituminous membrane over and terminate beyond eaves.

1. Unroll sheet and allow it to relax for the minimum time period required by manufacturer.
- B. Three-Ply, Modified Bituminous Membrane: Install 3 plies of modified bituminous membrane, consisting of a self-adhered base ply, torched inner ply and a torch mineral surfaced finish ply, starting at low point of roofing system.
1. Self Adhered Base Sheet Application: Starting at the low point of the roof, unroll Base sheet and allow the sheet to relax. Align the Base sheet so that it lies flat, with no wrinkles. Align subsequent rolls, shingling the laps, and maintaining a minimum 3" (76.2 mm) side lap and a minimum 6" (152.4 mm) end lap and repeat the application. Begin the attachment by removing half of the release paper backing from the membrane. Apply pressure to the top side of the exposed area, starting at the center and working out to the edges, to ensure continuous attachment to the substrate. Remove the remaining release-backing from the Base SA, keeping the membrane in contact with substrate and applying continuous pressure to the top of the sheet, from the center out to the edges.
 2. Inner and Finish Ply Application: Adhere each ply to self adhered base sheet by heat fusing torch applied method, following roof system manufacturers standard specifications.
- C. Laps: Accurately align sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.
1. Repair tears and voids in laps and lapped seams not completely sealed.
 2. Apply granules, while asphalt is hot, to cover asphalt bead extruded at laps.
- D. Install modified bituminous membranes with side laps shingled with slope of roof deck where possible.
1. Install modified bituminous membranes with side laps shingled in direction to shed water on each large area of roofing where slope exceeds ½ inch per 12 inches (1:24).

3.6 FLASHING AND STRIPPING INSTALLATION

- A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions, and as follows:
1. Prime substrates with asphalt primer if required by roofing system manufacturer.
 2. Backer Sheet Application: Adhere backer sheet to substrate in a solid mopping of hot roofing asphalt.
 3. Base Flashing Application: Torch apply flashing sheet to substrate.
- B. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane and 4 inches onto field of roofing membrane.
- C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing.
- D. Install roofing membrane cap-sheet stripping where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.
- E. Roof Drains: Set 30-by-30-inch square metal flashing in bed of asphalt roofing cement on completed roofing membrane. Cover metal flashing with roofing membrane cap-sheet stripping and extend a minimum of 6 inches beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
 1. Install stripping according to roofing system manufacturer's written instructions.

3.7 WALKWAY INSTALLATION

- A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size according to walkway pad manufacturer's written instructions.
 1. Set walkway pads in cold-applied adhesive.

3.8 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
 1. Notify Architect and Owner 48 hours in advance of date and time of inspection.
- B. Roofing system will be considered defective if it does not pass inspections.

3.9 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Retain paragraph below if coating membrane or if using fluid-applied bonding materials.
- D. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Manufactured Products:

- a. Manufactured reglets and counterflashing.

- 2. Formed Products:

- a. Formed roof drainage sheet metal fabrications.
 - b. Formed low-slope roof sheet metal fabrications.
 - c. Formed opening flashings in framed construction.
 - d. Formed equipment support flashing.

- B. Related Sections:

- 1. Division 07 Section "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for installing sheet metal flashing and trim integral with membrane roofing.
 - 2. Division 04 Section "Unit Masonry" for through wall sheet metal flashing.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
- C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F/67 deg C), ambient; 180 deg F/100 deg C), material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
 - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
 - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 4. Details of termination points and assemblies, including fixed points.
 - 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
 - 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 - 7. Details of special conditions.
 - 8. Details of connections to adjoining work.
 - 9. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches (1:5).
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
 - 3. Accessories and Miscellaneous Materials: Full-size Sample.

1.5 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof eave, including apron flashing, approximately 48" long, including supporting construction cleats, seams, attachments and accessories.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Contractor, Architect, Contractor's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
 - 2. Review methods and procedures related to sheet metal flashing and trim.
 - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
 - 5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209 (), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. Surface: Smooth, flat.
 - 2. Exposed Coil-Coated Finishes:
 - 3. Color: Match existing copings at adjacent Science East and Science Center buildings.
 - 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil(0.013 mm).
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.
 - 1. Finish: 2B (bright, cold rolled).
 - 2. Surface: Smooth, flat.

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils ()thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F(116 deg C).
 - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F(-29 deg C).
 - 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
 - c. Henry Company; Blueskin PE200 HT.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder:
1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions with interlocking counterflashing on exterior face, of same metal as reglet.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cheney Flashing Company.
 - b. Fry Reglet Corporation.
 - c. Heckmann Building Products Inc.
 - d. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
 2. Material: Stainless steel, 0.019 inch (0.48 mm) thick Aluminum, 0.024 inch (0.61 mm) thick.
 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 4. Masonry Type: Provide with offset top flange for embedment in masonry mortar

- joint.
5. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
 6. Finish: Mill.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet 6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch 3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch 25 mm) deep, filled with butyl sealant concealed within joints.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

- I. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
 1. Fabricate from the following materials:
 - a. Stainless Steel: 0.016 inch(0.40 mm) thick.
- B. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch- ()wide wall flanges to interior, and base extending 4 inches ()beyond cant or tapered strip into field of roof. Fabricate from the following materials:
 1. Stainless Steel: 0.019 inch(0.48 mm) thick.
- C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes. Fabricate from the following materials:
 1. Stainless Steel: 0.016 inch (0.40 mm)thick.
- D. Splash Pans: Fabricate from the following materials:
 1. Aluminum: 0.040 inch (1.02 mm)thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof-Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-(2400-mm-) long, but not exceeding 10-foot-(3-m-) long, sections. Furnish with 6-inch-(150-mm-) wide, joint cover plates.
 1. Joint Style: Butt, with 12-inch-(300-mm-) wide, concealed backup plate and 6-inch-(150-mm-) wide, exposed cover plates.
 2. Fabricate with scuppers spaced 10 feet (3 m) apart, of dimensions required with 4-inch-(100-mm-) wide flanges and base extending 4 inches(100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
 3. Fabricate from the following materials:
 - a. Stainless Steel: 0.016 inch (0.40 mm)) thick.
- B. Copings: Fabricate in minimum 96-inch-(2400-mm-) long, but not exceeding 10-foot-(3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
 1. Coping Profile: SMACNA figure designation 3-4A.
 2. Joint Style: Butt, with 6-inch-(150-mm-) wide, exposed cover plates.
 3. Fabricate from the following materials:
 - a. Aluminum
 - b. Color: Clear Anodized

- C. Roof and Roof to Wall Transition Expansion-Joint Cover: Fabricate from the following materials:
 - 1. Stainless Steel: 0.025 inch(0.64 mm) thick.
- D. Base Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.019 inch(0.48 mm) thick.
- E. Counterflashing: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inc (0.81 mm)h thick.
- F. Flashing Receivers: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch(0.81 mm) thick.
- G. Roof-Penetration Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.019 inch(0.48 mm) thick.
- H. Roof-Drain Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.016 inch(0.40 mm) thick.

2.8 WALL SHEET METAL FABRICATIONS

- A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches(100 mm) beyond wall openings. Form head and sill flashing with 2-inch-(50-mm-) high, end dams with continuous soldered joints. Hem exposed edges. Fabricate from the following materials:
 - 1. Stainless Steel: 0.025 inch(0.63 mm) thick, [24ga.]

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.019 inch(0.48 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions

detrimental to performance of the Work.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as indicated on Drawings.
- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches(150 mm) staggered 24 inches 600 mm) between courses. Overlap side edges not less than 3-1/2 inches90 mm). Roll laps with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches(300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 - 5. Install sealant tape where indicated.
 - 6. Torch cutting of sheet metal flashing and trim is not permitted.
 - 7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
 - 1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet3 m) with no joints allowed within 24 inches 600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch(25 mm) deep, filled with sealant concealed within joints.

- D. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- E. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder aluminum sheet.
 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.4 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.
1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
 2. Provide elbows at base of downspout to direct water away from building.
 3. Connect downspouts to underground drainage system indicated.
- C. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in asphalt roofing cement compatible with roofing membrane.
- D. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
1. Anchor scupper closure trim flange to exterior wall and solder to scupper.
 2. Loosely lock front edge of scupper with conductor head.
 3. Solder exterior wall scupper flanges into back of conductor head.
- E. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch (25 mm) below scupper gutter discharge.
- F. Expansion-Joint Covers: Install expansion-joint covers at locations and of

configuration indicated. Lap joints a minimum of 4 inches in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at 16-inch(400-mm) centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch(400-mm) centers.
 - 2. Anchor interior leg of coping with screw fasteners and washers at 24-inch(600-mm) centers.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches(100 mm) over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with sealant. anchor and washer at 36-inch(900-mm) centers.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Reglets: Installation of reglets is specified in Division 03 Section "Cast-in-Place Concrete."
- C. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings minimum or as indicated in drawings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077129 - MANUFACTURED ROOF EXPANSION JOINTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Dual-seal, double-flanged extruded roof expansion joints that transition to wall expansion joints.

- B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wooden curbs or cants for mounting roof expansion joints.
- 2. Section 075216 "Stryrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for roofing system.
- 3. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-fabricated sheet metal expansion-joint flashing, and other sheet metal items.
- 4. Section 079500 "Exterior Expansion Control" for exterior wall expansion control systems at walls below roof expansion joint transitions and other vertical expansion joint items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For roof expansion joints.

- 1. Include plans, elevations, sections, and attachment details.
- 2. Include details of splices, intersections, transitions, fittings, method of field assembly, and location and size of each field splice.
- 3. Provide isometric drawings of intersections, terminations, and changes in joint direction or planes, depicting how components interconnect with each other and adjacent construction to allow movement and achieve waterproof continuity.

- C. Samples: For each exposed product and for each color specified, 6 inches in size.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer of roofing membrane.
- B. System to be installed by qualified installer according to detailed published installation procedures and in accordance with job-specific installation instructions of manufacturer's field technician. Provide for presence of paid manufacturer's field technician to be present during initial preparation, inspection, and material installation.

1.6 WARRANTY

- A. Special Warranty: Manufacturer and Installer agree to repair or replace roof expansion joints and components that leak, deteriorate beyond normal weathering, or otherwise fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Roof expansion joints shall withstand exposure to weather, remain watertight, and resist the movements indicated without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint seals, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 EXTRUDED-TYPE ROOF EXPANSION JOINTS

- A. Source Limitations: Obtain bellows-type roof expansion joints approved by roofing manufacturer and that are part of roofing membrane warranty.
- B. Flanged Bellows Roof Expansion Joint - **REJ1**: Manufactured, continuous, waterproof, joint-cover assembly, consisting of a heat weldable, PVC FlexAlloy extrusion with dual-level flange, manufacturer supplied termination bar and anchors and factory welded downturn transition in the RoofJoint gland that is sealed at a ship-lapped 45-degree angle to mate with an interlocking factory-fabricated RoofJoint/COLORSEAL transition piece. Provide each size and type indicated factory-fabricated units for corner and joint intersections and horizontal and vertical transitions, splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation. Fabricate each assembly specifically for installation configuration indicated on Drawings.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide

product indicated on Drawings.

- a. Emseal Joint Systems, LTD, Roofjoint with horizontal Colorseal.
2. Joint Movement Capability: Plus and minus 100 percent of joint size.
3. Material: PVC Flexalloy for direct welding and adhesion to SBS roof membrane.
 - a. Color: UV stable gray.
4. Flanges: PVC Flexalloy for direct welding and adhesion to SBS roof membrane.
 - a. Form: As indicated on Drawings.
5. Secondary Seal: Continuous, waterproof preformed, pre-compressed, self-expanding cellular foam with silicone pre-coated sealant system within joint and attached to substrate on sides of joint below the primary assembly.
6. Roof-to-Wall Closure Type: Emseal Cavity-wall closure as indicated in drawings.

2.3 MATERIALS

- A. Silicone Extrusions: Low modulus, ASTM D 2000, UV stabilized, and that does not propagate flame with a backing of acrylic impregnated expanding foam and with a VOC content of 40 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.
- C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine roof-joint openings, inside surfaces of parapets, and expansion-control joint systems that interface with roof expansion joints, for suitable conditions where roof expansion joints will be installed.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for handling and installing roof expansion joints.

1. Anchor roof expansion joints securely in place, with provisions for required movement. Use fasteners, protective coatings, sealants, and miscellaneous items as required to complete roof expansion joints.
 2. Install roof expansion joints true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 3. Provide for linear thermal expansion of roof expansion joint materials.
 4. Provide uniform profile of roof expansion joint throughout its length; do not stretch or squeeze membranes.
 5. Provide uniform, neat seams.
 6. Install roof expansion joints to fit substrates and to result in watertight performance.
 7. Torch cutting of roof expansion joints is not permitted.
 8. Do not use graphite pencils to mark aluminum surfaces.
- B. Directional Changes and Other Expansion-Control Joint Systems: Coordinate installation of roof expansion joints with other expansion-control joint systems to result in watertight performance. Install factory-fabricated units at directional changes and at transitions between roof expansion joints and exterior expansion-control joint systems specified in Section 079500 "Expansion Control" to provide continuous, uninterrupted, and watertight joints.
- C. Splices: Splice roof expansion joints with materials provided by roof-expansion-joint manufacturer for this purpose, to provide continuous, uninterrupted, and waterproof joints.
- D. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
- 3.3 PROTECTION
- A. Protect roof expansion joints from foot traffic, displacement, or other damage.
- B. Remove and replace roof expansion joints and components that become damaged by moisture or otherwise.

END OF SECTION 077129

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof curbs.
 - 2. Equipment supports.
 - 3. Roof hatches.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure.
 - 3. Required clearances.
- B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and

maintenance manuals.

1.7 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leak-proof, weather-tight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

- A. Aluminum Sheet: ASTM B 209), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
 - 1. Mill Finish: As manufactured.
 - 2. Concealed Finish: Pre-treat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil).
- B. Aluminum Extrusions and Tubes: ASTM B 221), manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.
- C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide non-removable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 - 1. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

2.3 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
 - 1. Manufacturers: Subject to compliance with requirements, available

manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Curbs Plus, Inc.
 - b. Greenheck Fan Corporation.
 - c. Thybar Corporation.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Stainless-steel sheet, 0.078 inch) thick.
1. Finish: Manufacturer's standard.

2.4 EQUIPMENT SUPPORTS

- A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Curbs Plus, Inc.
 - b. Greenheck Fan Corporation.
 - c. Thybar Corporation.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

2.5 ROOF HATCH

- A. Roof Hatches: Metal roof-hatch units with lids and insulated -walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weather-tight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bilco Company (The), Type NB, 36"x54"
 - b. Dur-Red Products.
 - c. Nystrom.
- B. Loads: Minimum 40-lbf/sq. ft.)external live load and 20-lbf/sq. ft.)internal uplift load.
- C. Hatch Material: Stainless-steel sheet, 0.078 inch)thick.
- D. Construction:

1. Insulation: board.
 2. Fabricate curbs to minimum height of 12 inches) unless otherwise indicated.
- E. Hardware: Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
1. Provide two-point latch on lids larger than 84 inches).
- F. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
1. Height: 42 inches)above finished roof deck.
 2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches)in diameter or galvanized-steel tube, 1-5/8 inches)in diameter.
 3. Flat Bar: Galvanized steel, 2 inches)high by 3/8 inch)thick.
 4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches)in diameter.
 5. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
 6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
 7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
 8. Fabricate joints exposed to weather to be watertight.
 9. Fasteners: Manufacturer's standard, finished to match railing system.
 10. Finish: Manufacturer's standard.
 - a. Color: High visibility safety yellow.
- G. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
 2. Height: 42 inches) above finished roof deck.
 3. Material: Aluminum.
 4. Post: 1-5/8-inch-)diameter pipe.
 5. Finish: Manufacturer's standard baked enamel or powder coat.
 - a. Color: As selected by Architect from manufacturer's full range.
- 2.6 GENERAL FINISH REQUIREMENTS
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
 - 5. All penetrations to receive pre-formed flashing boots. Pitch pockets are not acceptable. Gang smaller roof penetrations as required to allow fewer penetrations to roof membrane. No roof penetrations shall be less than 2" in diameter.
 - 6. Keep all roof penetrations a minimum of 2'-6" from adjacent construction to allow for proper pipe-sleeve installation and flashing.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- E. Roof-Hatch Installation:
 - 1. Install roof hatch so top surface of hatch curb is level.
 - 2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 - 3. Attach safety railing system to roof-hatch curb.

4. Attach ladder-assist post according to manufacturer's written instructions.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Division 09 painting Sections.
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078100 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Concealed SFRM.
- B. Related Sections include the following:
 - 1. Division 05 Section "Structural Steel Framing" for surface conditions required for structural steel receiving SFRM.
 - 2. Division 07 Section "Thermal Insulation" for fire-safing insulation.
 - 3. Division 07 Section "Penetration Firestopping" for fire-resistance-rated firestopping systems.
 - 4. Division 07 Section "Fire-Resistive Joint Systems" for fire-resistance-rated joint systems.

1.3 DEFINITIONS

- A. SFRM: Sprayed fire-resistive material.
- B. Concealed: Fire-resistive materials applied to surfaces that are concealed from view behind other construction when the Work is completed and have not been defined as exposed.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Structural framing plans indicating the following:
 - 1. Locations and types of surface preparations required before applying SFRM.
 - 2. Extent of SFRM for each construction and fire-resistance rating, including the following:
 - a. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1) For steel joist assemblies, include applicable fire-resistance design designations, with each steel joist tested with the same maximum tensile stress as each steel joist indicated on Drawings. Design designations with steel joists tested at lower maximum tensile stress than those indicated are not permitted.

- b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.
- 3. Treatment of SFRM after application.
- C. Samples for Verification: For each type of colored, exposed SFRM, two Samples, each 4 inches (102 mm) square, of each color, texture, and material formulation to be applied. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
- D. Product Certificates: For each type of SFRM, signed by product manufacturer.
- E. Qualification Data: For Installer, manufacturer, professional engineer, and testing agency.
- F. Compatibility and Adhesion Test Reports: From SFRM manufacturer indicating the following:
 - 1. Materials have been tested for bond with substrates.
 - 2. Materials have been verified by SFRM manufacturer to be compatible with substrate primers and coatings.
 - 3. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for proposed SFRM.
- H. Research/Evaluation Reports: For SFRM.
- I. Field quality-control test and special inspection reports.
- J. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by SFRM manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its SFRM to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.
- B. Source Limitations: Obtain SFRM through one source from a single manufacturer.
- C. SFRM Testing: By a qualified testing and inspecting agency engaged by Contractor or manufacturer to test for compliance with specified requirements for performance and test methods.
 - 1. SFRMs are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Testing is performed on specimens of SFRMs that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.

3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.
- D. Compatibility and Adhesion Testing: Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.
1. Test for bond per ASTM E 736 and requirements in UL's "Fire Resistance Directory" for coating materials. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with SFRM.
- E. Fire-Test-Response Characteristics: Provide SFRM with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify bags containing SFRM with appropriate markings of applicable testing and inspecting agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or Omega Point Laboratories Inc. Directory of Listed Building Products, Materials and Assemblies acceptable to authorities having jurisdiction, for SFRM serving as direct-applied protection tested per ASTM E 119.
 2. Surface-Burning Characteristics: ASTM E 84.
- F. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."
- G. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Extent of Mockups: Approximately 100 sq. ft. (9 sq. m) of surface for each product indicated.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to SFRM including, but not limited to, the following:
1. Review products, exposure conditions, design ratings, restrained and unrestrained conditions, calculations, densities, thicknesses, bond strengths, and other performance requirements.
 2. Review and finalize construction schedule and verify sequencing and coordination requirements.
 3. Review weather predictions, ambient conditions, and proposed temporary protections for SFRM during and after installation.
 4. Review surface conditions and preparations.
 5. Review field quality-control testing procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to Project.
- B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.
- C. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from Project site and discard wet or deteriorated materials.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply SFRM when ambient or substrate temperature is 40 deg F (4 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of SFRM. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.8 COORDINATION

- A. Sequence and coordinate application of SFRM with other related work specified in other Sections to comply with the following requirements:
 - 1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
 - 2. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
 - 3. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
 - 4. Do not apply fire-resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
 - 5. Do not apply fire-resistive material to metal floor deck substrates until concrete topping has been completed.
 - 6. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
 - 7. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
 - 8. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace SFRMs that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
 - b. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCEALED SFRM

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. Concealed Cementitious SFRM:
 - a. Carbolite Co., Fireproofing Products Div.; Pyrolite 15 High Yield.
 - b. Grace, W. R. & Co. - Conn., Construction Products Div.; Monokote Type MK-6, MK-6/HY and MK-6s.
 - c. Isolatek International Corp.; Cafco 300.
 - d. Southwest Vermiculite Co., Inc.; Type 5.
 - e. Carbolite Co., Fireproofing Products Div.; Pyrolite 15 Blue.
 - f. Grace, W. R. & Co. - Conn., Construction Products Div.; Retro-Gard.
 - g. Isolatek International Corp.; Cafco 300 SB.
 2. Concealed Sprayed-Fiber Fire-Resistive Material:
 - a. Isolatek International Corp.; Cafco Blaze-Shield II.
- B. Material Composition: Manufacturer's standard product, or either of the following as required:
1. Concealed Cementitious SFRM: Factory-mixed, dry formulation of gypsum or portland cement binders, additives, and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.
 2. Concealed Sprayed-Fiber Fire-Resistive Material: Factory-mixed, dry formulation of inorganic binders, mineral fibers, fillers, and additives conveyed in a dry state by pneumatic equipment and mixed with water at spray nozzle to form a damp, as-applied product.
- C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:

1. Dry Density: 15 lb/cu. ft. (240 kg/cu. m) for average and individual densities, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWC Technical Manual 12-A, Section 5.4.5, "Displacement Method."
2. Thickness: Minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 0.375 inch (9 mm), per ASTM E 605:
 - a. Where the referenced fire-resistance design lists a thickness of 1 inch (25 mm) or more, the minimum allowable individual thickness of SFRM is the design thickness minus 0.25 inch (6 mm).
 - b. Where the referenced fire-resistance design lists a thickness of less than 1 inch (25 mm) but more than 0.375 inch (9 mm), the minimum allowable individual thickness of SFRM is the greater of 0.375 inch (9 mm) or 75 percent of the design thickness.
 - c. No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft. (240 kg/cu. m).
3. Bond Strength: 150 lbf/sq. ft. (7.2 kPa) minimum per ASTM E 736 based on laboratory testing of 0.75-inch (19-mm) minimum thickness of SFRM.
4. Compressive Strength: 5.21 lbf/sq. in. (35.9 kPa) minimum per ASTM E 761. Minimum thickness of SFRM tested shall be 0.75 inch (19 mm) and minimum dry density shall be as specified but not less than 15 lb/cu. ft. (240 kg/cu. m).
5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
6. Deflection: No cracking, spalling, or delamination per ASTM E 759.
7. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of SFRM is 0.75 inch (19 mm), maximum dry density is 15 lb/cu. ft. (240 kg/cu. m), test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.
9. Fire-Test-Response Characteristics: Provide SFRM with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Spread Index: 10 or less.
 - b. Smoke-Developed Index: 0.
10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

2.2 AUXILIARY FIRE-RESISTIVE MATERIALS

- A. General: Provide auxiliary fire-resistive materials that are compatible with SFRM and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:
 1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory" for coating materials based on a series of bond tests per ASTM E 736.
 2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of SFRM per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

- C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of SFRM.
- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistance designs indicated and fire-resistive material manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive SFRM.
- E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by manufacturer of SFRM.
- F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by manufacturer of intumescent mastic coating fire-resistive material. Include pins and attachment.
- G. Sealer for Sprayed-Fiber Fire-Resistive Material: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by manufacturer of sprayed-fiber fire-resistive material.
 - 1. Product: Subject to compliance with requirements, provide "Cafco Bond-Seal" by Isolatek International Corp.
- H. Topcoat: Type recommended in writing by manufacturer of each SFRM for application over concealed SFRM.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:
 - 1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
 - 2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, incompatible encapsulants, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
 - 3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
- B. Verify that concrete work on steel deck has been completed.
- C. Verify that roof construction, installation of roof-top HVAC equipment, and other related work are completed.
- D. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.
- B. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers, paints, and encapsulants.
- C. Prime substrates where recommended in writing by SFRM manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive SFRM.
- D. For exposed applications, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of SFRM. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION, GENERAL

- A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- B. Apply SFRM that is identical to products tested as specified in Part 1 "Quality Assurance" Article and substantiated by test reports, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.
- C. Install metal lath and reinforcing fabric, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath and fabric to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by SFRM manufacturer. Attach accessories where indicated or required for secure attachment of lath and fabric to substrate.
- D. Coat substrates with bonding adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by SFRM manufacturer for material and application indicated.
- E. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by SFRM manufacturer, install body of fire-resistive covering in a single course.
- F. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by SFRM manufacturer.
- G. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply SFRM that differs in color from that of encapsulant over which it is applied.
- H. Where sealers are used, apply products that are tinted to differentiate them from SFRM over which they are applied.

3.4 APPLICATION, CONCEALED SFRM

- A. Apply concealed SFRM in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if specified in Part 2 "Concealed SFRM" Article.
- B. Apply water overspray to concealed sprayed-fiber fire-resistive material as required to obtain designated fire-resistance rating and where indicated.
- C. Cure concealed SFRM according to product manufacturer's written recommendations.
- D. Apply sealer to concealed SFRM where indicated.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspection and prepare reports:
 - 1. SFRM.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- C. Tests and Inspections: Testing and inspecting of completed applications of SFRM shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of SFRM for the next area until test results for previously completed applications of SFRM show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.
 - 1. Thickness for Floor, Roof, and Wall Assemblies: For each 1000-sq. ft. (93-sq. m) area, or partial area, on each floor, from the average of 4 measurements from a 144-sq. in. (0.093-sq. m) sample area, with sample width of not less than 6 inches (152 mm) per ASTM E 605.
 - 2. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
 - 3. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
 - 4. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: For each 10,000-sq. ft. (929 sq. m) area, or partial area, on each floor, cohesion and adhesion from one sample of size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 736.
 - a. Field test SFRM that is applied to flanges of wide-flange, structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.

- b. If surfaces of structural steel receiving SFRM are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than 150 lbf/sq. ft. (7.2 kPa) minimum per ASTM E 736.
- 5. If testing finds applications of SFRM are not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.
- D. Remove and replace applications of SFRM that do not pass tests and inspections for cohesion and adhesion, for density, or for both and retest as specified above.
- E. Apply additional SFRM, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements, and retest as specified above.

3.6 CLEANING, PROTECTING, AND REPAIR

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect SFRM, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.
- C. Coordinate application of SFRM with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect SFRM and patch any damaged or removed areas.
- D. Repair or replace work that has not successfully protected steel.

END OF SECTION 078100

SECTION 078123 – INTUMESCENT FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes mastic and intumescent fire-resistive coatings (MIFRC) at all exposed steel in stair shafts.
- B. Related Requirements:
 - 1. Division 07 Section "Applied Fireproofing" for sprayed fire-resistive materials (SFRM).

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.2: For paints and coatings, documentation including printed statement of VOC content.
- C. Shop Drawings: Structural framing plans indicating the following:
 - 1. Extent of fireproofing for each construction and fire-resistance rating.
 - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
 - 4. Treatment of fireproofing after application.
- D. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from ICC-ES.
- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 50 deg F (10 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction and the following VOC limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Primers, Sealers, and Undercoaters: 200 g/L.
 - 4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 5. Fireproofing Exterior Coatings: 350 g/L.
- E. Asbestos: Provide products containing no detectable asbestos.

2.2 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

- A. MIFRC: Manufacturer's standard, factory-mixed formulation or factory-mixed, multicomponent system consisting of intumescent base coat and topcoat, and complying with indicated fire-resistance design.

1. Application: Designated for "interior general purpose" and "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
2. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
3. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
4. Finish: As selected by Architect from manufacturer's standard finishes.
 - a. Color and Gloss: Match Architect's sample.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.
- D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.
- E. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:
 1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
 2. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 3. Substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

- B. Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
 - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
 - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- E. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- F. Extend fireproofing in full thickness over entire area of each substrate to be protected.

- G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- I. Cure fireproofing according to fireproofing manufacturer's written recommendations.
- J. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- K. Finishes: Where indicated, apply fireproofing to produce the following finishes:
 - 1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
 - 2. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
 - 3. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.
 - 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
 - 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.

- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078123

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
- B. Related Sections include the following:
 - 1. Division 07 Section "Fire-Resistive Joint Systems."
 - 2. Division 21 Sections specifying fire-suppression piping penetrations.
 - 3. Division 22 and 23 Sections specifying duct and piping penetrations.
 - 4. Division 26, 27, and 28 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814:
 - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 - 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - a. Penetrations located outside wall cavities.
 - b. Penetrations located outside fire-resistance-rated shaft enclosures.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.

3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
 2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
 1. Types of penetrating items.
 2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
 3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
- D. Qualification Data: For Installer.
- E. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.
- F. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application in the Through-Penetration Firestop System Schedule at the end of Part 3 that are produced by one of the following manufacturers:
1. A/D Fire Protection Systems Inc.
 2. Grace, W. R. & Co. - Conn.
 3. Hilti, Inc.
 4. Johns Manville.
 5. Minnesota Mining and Manufacturing.
 6. Nelson Firestop Products.
 7. NUCO Inc.
 8. RectorSeal Corporation (The).
 9. Specified Technologies Inc.
 10. 3M; Fire Protection Products Division.
 11. Tremco; Sealant/Weatherproofing Division.
 12. USG Corporation.

2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-/rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.
 5. Steel sleeves.

2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.
- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.
- J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
 - 3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if

required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Through-penetration firestop system designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Through-penetration firestop system manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Contractor will engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.
- B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.7 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestop Systems with No Penetrating Items:
 - 1. Available UL-Classified Systems: C-AJ-0001-0999; W-L-0001-0999.
- C. Firestop Systems for Metallic Pipes, Conduit, or Tubing:
 - 1. Available UL-Classified Systems: C-AJ-1001-1999; W-L-1001-1999.
- D. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:
 - 1. Available UL-Classified Systems: C-AJ-2001-2999; W-L-2001-2999.
- E. Firestop Systems for Electrical Cables:
 - 1. Available UL-Classified Systems: C-AJ-3001-3999; W-L-3001-3999.
- F. Firestop Systems for Cable Trays:
 - 1. Available UL-Classified Systems: C-AJ-4001-4999; W-L-4001-4999.
- G. Firestop Systems for Insulated Pipes:
 - 1. Available UL-Classified Systems: C-AJ-5001-5999; W-L-5001-5999.
- H. Firestop Systems for Miscellaneous Electrical Penetrants:
 - 1. Available UL-Classified Systems: C-AJ-6001-6999; W-L-6001-6999.
- I. Firestop Systems for Miscellaneous Mechanical Penetrants:
 - 1. Available UL-Classified Systems: C-AJ-7001-7999; W-L-7001-7999.
- J. Firestop Systems for Groupings of Penetrants:
 - 1. Available UL-Classified Systems: C-AJ-8001-8999; W-L-8001-8999.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes fire-resistive joint systems for the following:
 - 1. Floor-to-floor joints.
 - 2. Floor-to-wall joints.
 - 3. Head-of-wall joints.
 - 4. Wall-to-wall joints.
 - 5. Perimeter fire-resistive joint systems consisting of floor-to-wall joints between perimeter edge of fire-resistance-rated floor assemblies and exterior curtain walls.
- B. Related Sections include the following:
 - 1. Division 07 Section "Penetration Firestopping" for systems installed in openings in walls and floors with and without penetrating items.
 - 2. Division 07 joint sealant sections for non-fire-resistive joint sealants.
 - 3. Division 07 expansion control sections for fire-resistive joint systems consisting of metal frames and covers.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.
- B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities indicated as determined by UL 2079.
 - 1. Load-bearing capabilities as determined by evaluation during the time of test.
- C. Perimeter Fire-Resistive Joint Systems: For joints between edges of fire-resistance-rated floor assemblies and exterior curtain walls, provide systems of type and with ratings indicated below and those indicated in the Fire-Resistive Joint System Schedule at the end of Part 3, as determined by NFPA 285 and UL 2079.

1. UL-Listed, Perimeter Fire-Containment Systems: Integrity ratings equaling or exceeding fire-resistance ratings of floor or floor/ceiling assembly forming one side of joint.
 2. OPL-Listed, Perimeter Fire-Barrier Systems: F-ratings equaling or exceeding fire-resistance ratings of floor or floor/ceiling assembly forming one side of joint.
- D. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.
1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.
- C. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.
- D. Qualification Data: For Installer.
- E. Field quality-control test reports.
- F. Evaluation Reports: Evidence of fire-resistive joint systems' compliance with ICBO ES AC30, from the ICBO Evaluation Service.
- G. Research/Evaluation Reports: For each type of fire-resistive joint system.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."
- B. Installation Responsibility: Assign installation of fire-resistive joint systems in Project to a single qualified installer.
- C. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.
- D. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, OPL or another agency performing testing

and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.

2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:
 - a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
 - b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify Owner's inspecting agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector of authorities having jurisdiction have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the fire-resistive joint systems indicated for each application in the Fire-Resistive Joint System Schedule at the end of Part 3.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

- A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.
- B. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would

otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.
- B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Inspecting Agency: Contractor will engage a qualified independent inspecting agency to inspect fire-resistive joint systems and prepare inspection reports.
- B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.
 - 1. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.
- C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.
- D. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.6 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

- A. Designation System for Joints in or between Fire-Resistance-Rated Constructions: Alphanumeric systems listed in UL's "Fire Resistance Directory" under Product Category XHBN.
- B. Designation System for Joints at the Intersection of Fire-Resistance-Rated Floor or Floor/Ceiling Assembly and an Exterior Curtain-Wall Assembly: Alphanumeric systems listed in UL's "Fire Resistance Directory" under Product Category XHDG or OPL's "Directory of Listed Building Products, Materials, & Assemblies" as perimeter fire-barrier systems:
- C. Floor-to-Floor Fire-Resistive Joint Systems:
 - 1. Available UL-Classified Systems: FF-D-0000-0999.
 - 2. Assembly Rating: 2 hours.
 - 3. Nominal Joint Width: 2-inches (51 mm) unless indicated otherwise.
 - 4. Movement Capabilities: 50 percent compression or extension.
- D. Floor-to-Wall Fire-Resistive Joint Systems:
 - 1. Available UL-Classified Systems: FW-D-0000-1999.
 - 2. Assembly Rating: 2 hours.
 - 3. Nominal Joint Width: 4 inches (102 mm) unless indicated otherwise.
 - 4. Movement Capabilities: 25 percent compression or extension.
- E. Head-of-Wall Fire-Resistive Joint Systems :
 - 1. Available UL-Classified Systems: HW-D-0000-1999.
 - 2. Assembly Rating: 2 hours.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: 25 percent compression or extension.
- F. Wall-to-Wall Fire-Resistive Joint Systems:
 - 1. Available UL-Classified Systems: WW-D-0000-0999.
 - 2. Assembly Rating: 2 hours unless indicated otherwise.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: 25 percent compression or extension.
- G. Perimeter Fire-Resistive Joint Systems:

1. Available OPL-Classified Perimeter Fire-Barrier Systems: CEJ-116-P.
 - a. T-Rating: 1/4 hour.
 - b. F-Rating: 2 hours.
 - c. Linear Opening Width: As indicated.
 - d. L-Rating at Ambient Temperature: Less than 1 cfm/lin. ft. (<Insert number> cu. m/s x sq. m).
 - e. Movement Capabilities per ASTM E 1399: 16.7 percent movement.

END OF SECTION 078446

SECTION 079200 – INTERIOR JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Acoustical Joint Sealants

- B. Related Sections:

1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 07 expansion control sections for building expansion joints.
3. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
4. Division 07 Section "Exterior Joint Sealants" for sealing joints in exterior construction.
5. Division 08 Section "Structural-Sealant-Glazed Curtain Walls" for structural and other glazing sealants.
6. Division 08 Section "Glazing" for glazing sealants.
7. Division 09 Section "Gypsum Board" for sealing perimeter joints.
8. Division 09 Section "Tiling" for sealing tile joints.
9. Division 32 Section "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than 3 pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 2. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate indicated.
 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. LEED Submittal:
 1. Product Data for Credit EQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long

strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

- E. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.
- F. Qualification Data: For qualified Installer.
- G. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- H. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- J. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- K. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- L. Field-Adhesion Test Reports: For each sealant application tested.
- M. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- E. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- F. Colors of Exposed Joint Sealants: Match to adjacent finish color as approved by Architect'.

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation;
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. Pecora Corporation; Sika Corporation, Construction Products Division; SikaSil-C990.
 - d. Tremco Incorporated;

- B. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation; 898.

2.3 URETHANE JOINT SEALANTS

- A. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems; Sonolastic SL 1.
 - b. Pecora Corporation; Urexpan NR-201.
 - c. Sika Corporation. Construction Products Division; Sikaflex - 1CSL.
 - d. Tremco Incorporated; Vulkem 45.

2.4 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolac.
 - b. Pecora Corporation; AC-20+.
 - c. Tremco Incorporated; Tremflex 834.

2.5 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; AC-20 FTR.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.

2.6 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for

applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.

- b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
- 3. Remove laitance and form-release agents from concrete.
- 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test

locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in stone flooring.
 - c. Control and expansion joints in brick flooring.
 - d. Control and expansion joints in tile flooring.
 - e. Other joints as indicated.
 2. Silicone Joint Sealant: Single component, pourable, traffic grade, neutral curing.
 3. Urethane Joint Sealant: Single component, pourable, traffic grade.
- B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.

- c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
 - f. Other joints as indicated.
 2. Joint Sealant: Latex.
 3. Joint-Sealant Color: Match to adjacent finish color from manufacturer's full range as approved by Architect'.
- C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated.
 2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.
 3. Joint-Sealant Color: Match to adjacent finish color from manufacturer's full range as approved by Architect'.
- D. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
 1. Joint Location:
 - a. Acoustical joints where indicated.
 - b. Other joints as indicated.
 2. Joint Sealant: Acoustical.
 3. Joint-Sealant Color: Match to adjacent finish color from manufacturer's full range as approved by Architect'.

END OF SECTION 079200

SECTION 079201 – EXTERIOR JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Silicone joint sealants.
- 2. Urethane joint sealants.

- B. Related Sections:

- 1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

- 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- 2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
- 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
- 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
- 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

- 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
- 2. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate indicated.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. LEED Submittals:
 1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- C. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 1. Materials forming joint substrates and joint-sealant backings have been tested for

- compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

- D. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- E. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- D. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint

sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. **Compatibility:** Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. **VOC Content of Interior Sealants:** Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. **Liquid-Applied Joint Sealants:** Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 1. **Suitability for Immersion in Liquids.** Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. **Stain-Test-Response Characteristics:** Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. **Colors of Exposed Joint Sealants:** As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. **Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant:** ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 1. **Products:** Subject to compliance with requirements, provide one of the following:

- a. Dow Corning Corporation; 790.
- b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
- c. Sika Corporation, Construction Products Division; SikaSil-C990.

2.3 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same

procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints in unit masonry.
 - b. Joints between different materials and those listed above.
 - c. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - d. Control and expansion joints in overhead surfaces.
 - 2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079201

SECTION 079500 – EXTERIOR EXPANSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Exterior wall expansion control systems.

- B. Related Requirements:

- 1. Section 077129 "Manufactured Roof Expansion Joints" for factory-fabricated roof expansion control.
 - 2. Section 079200 "Joint Sealants" for liquid-applied joint sealants and for elastomeric sealants without metal frames.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- B. Samples: For each expansion control system and for each color and texture specified, full width by 6 inches long in size.
- C. Samples for Verification: For each type of expansion control system indicated, full width by 6 inches long in size.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated. Refer to Division 01 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with the Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and ICC A117.1.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
 2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.
- B. Coordination: Coordinate installation of exterior wall and soffit expansion control systems with roof expansion control systems to ensure that wall transitions are watertight. Roof expansion joints and transition-to-wall assemblies are specified elsewhere.

2.2 EXTERIOR WALL EXPANSION CONTROL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or a comparable product:
1. EMSEAL Corporation, Colorseal.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- C. Wall-to-Wall – **EJ1**: Preformed, Pre-Compressed, Self-Expanding, Sealant System with Silicone Pre-Coated Surface, Watertight, Energy-Efficient, Exterior Above-Grade Wall Joints
1. Basis-of-Design Product: As indicated, EMSEAL Corporation, Colorseal with cover plate by Construcion Specialtoes, Inc.
 2. Design Criteria:
 - a. Nominal Joint Width: 2 inches.
 - b. Movement Capability: 50 percent: (-25 percent/+25 percent).
 - c. Type of Movement: Thermal / Differential.
 3. Cover plate:

- a. Metal: Aluminum.
 - b. Finish: Anodized.

4. Type: Preformed cellular foam.
 - a. Foam Material: Continuous, waterproof, preformed, pre-compressed, self-expanding cellular foam impregnated with a water-based, non-drying, 100% acrylic dispersion. Seal shall combine factory-applied, low-modulus silicone and a backing of acrylic-impregnated expanding foam into a unified hybrid sealant system.
 - b. Color: As selected by Architect from manufacturer's full range.

- D. Wall Corner – **EJ3**: Preformed, Pre-Compressed, Self-Expanding, Sealant System with Silicone Pre-Coated Surface, Watertight, Energy-Efficient, Exterior Above-Grade Wall Corner Joints.
 1. Basis-of-Design Product: As indicated, EMSEAL Corporation, Colorseal with cover plate by Construcion Specialtoes, Inc.
 2. Design Criteria:
 - a. Nominal Joint Width: 2 inches.
 - b. Movement Capability: 50 percent: (-25 percent/+25 percent).
 - c. Type of Movement: Thermal / Differential.
 3. Cover plate:
 - a. Metal: Aluminum.
 - b. Finish: Anodized.
 4. Type: Preformed cellular foam.
 - a. Foam Material: Continuous, waterproof, preformed, pre-compressed, self-expanding cellular foam impregnated with a water-based, non-drying, 100% acrylic dispersion. Seal shall combine factory-applied, low-modulus silicone and a backing of acrylic-impregnated expanding foam into a unified hybrid sealant system.
 - 1) Color: As selected by Architect from manufacturer's full range.

- E. Soffit-to-Soffit – **EJ5**: Preformed, Pre-Compressed, Self-Expanding, Sealant System with Silicone Pre-Coated Surface, Watertight, Energy-Efficient, Exterior Above-Grade Horizontal Joints.
 1. Basis-of-Design Product: As indicated, EMSEAL Corporation, Colorseal with cover plate by Construcion Specialtoes, Inc.
 2. Design Criteria:
 - a. Nominal Joint Width: 2 inches.
 - b. Movement Capability: 50 percent: (-25 percent/+25 percent).
 - c. Type of Movement: Thermal / Differential.

3. Cover plate:
 - a. Metal: Aluminum.
 - b. Finish: Anodized.

4. Type: Preformed cellular foam.
 - a. Foam Material: Continuous, waterproof, preformed, pre-compressed, self-expanding cellular foam impregnated with a water-based, non-drying, 100% acrylic dispersion. Seal shall combine factory-applied, low-modulus silicone and a backing of acrylic-impregnated expanding foam into a unified hybrid sealant system.
 - 1) Color: As selected by Architect from manufacturer's full range.

2.3 MATERIALS

- A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.
 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Silicone: Low-modulus with VOC content not to exceed 40g/L..
- C. Cellular Foam Seals: Expanding foam to be cellular foam impregnated with a water-based, non-drying, 100% acrylic dispersion. Seal shall combine factory-applied, low-modulus silicone and a backing of acrylic-impregnated expanding foam into a unified hybrid sealant system.
- D. Provide pre-compressed to less than the joint size, packaged in shrink-wrapped lengths (sticks) with a mounting adhesive on one face.
- E. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion control system manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.
- B. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both frame interfaces before installing compression seals.
- C. Foam Seals: Install with adhesive recommended by manufacturer.
- D. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.
- E. Directional changes and terminations into horizontal plane surfaces to be provided by factory-manufactured universal-90-degree single units containing minimum 12-inch long leg and 6-inch long leg or custom leg on each side of the direction change or through field fabrication in strict accordance with installation instructions.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due

to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION 079500

SECTION 079500 – INTERIOR EXPANSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior architectural joint systems.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for cast-in architectural-joint-system frames furnished, but not installed, in this Section.
 - 2. Division 04 Section "Unit Masonry" for masonry wall joint systems.
 - 3. Division 07 Section "Exterior Expansion Control " for exterior joint expansion control.
 - 4. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal wall joint systems.

1.3 DEFINITIONS

- A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage (plus or minus) of nominal value of joint width.
- D. Nominal Joint Width: The width of the linear opening specified in practice and in which the joint system is installed.

1.4 SUBMITTALS

- A. Shop Drawings: Provide the following for each joint system specified:
 - 1. Placement Drawings: Include line diagrams showing plans, elevations, sections, details, splices, blockout requirement, entire route of each joint system, and attachments to other work. Where joint systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

2. Architectural Joint System Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - a. Manufacturer and model number for each joint system.
 - b. Joint system location cross-referenced to Drawings.
 - c. Nominal joint width.
 - d. Movement capability.
 - e. Classification as thermal or seismic.
 - f. Materials, colors, and finishes.
 - g. Product options.
 - h. Fire-resistance ratings.
- B. Samples for Verification: For each type of architectural joint system indicated.
 1. Full width by 6 inches long, for each system required.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for current products.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated. Refer to Division 01 Section "Product Requirements."
 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Accessibility Requirements: Comply with applicable provisions in [the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and ICC A117.1.
- E. Fire-Test-Response Characteristics: Where indicated, provide architectural joint system and fire-barrier assemblies identical to those of assemblies tested for fire resistance per UL 2079 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies shall be subjected to hose stream testing.

1.6 COORDINATION

- A. Coordinate installation of exterior wall and soffit joint systems with roof expansion assemblies to ensure that wall transitions are watertight. Roof expansion assemblies are specified in Division 07.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.
 - 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
 - 2. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- B. Elastomeric Seals: Preformed elastomeric membranes or extrusions to be installed in metal frames.
- C. Compression Seals: ASTM E 1612; preformed rectangular elastomeric extrusions having internal baffle system and designed to function under compression.
- D. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required rating period.
- E. Moisture Barrier: Flexible elastomeric material, PVC, minimum 30 mils thick.
- F. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.2 ARCHITECTURAL JOINT SYSTEMS, GENERAL

- A. General: Provide architectural joint systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
 - 1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where joint changes direction or abuts other materials.
 - 2. Include factory-fabricated closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
- B. Design architectural joint systems for the following size and movement characteristics:
 - 1. Nominal Joint Width: As indicated on Drawings.
 - 2. Movement Capability: Plus or minus 50 percent.
 - 3. Type of Movement: Thermal.

2.3 ARCHITECTURAL JOINT SYSTEMS FOR BUILDING INTERIORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
 2. Balco, Inc.
 3. Construction Specialties, Inc.
 4. JointMaster/InPro Corporation.
 5. MM Systems Corporation.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- C. Horizontal – Floor-to-Wall (**EJ-1**):
1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model GFTW-200
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- D. Horizontal – Floor-to-Floor (**EJ-2**):
1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model GFT-200
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- E. Vertical – Wall-to-Corner (**EJ-3**):
1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWFC-200M

- 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and horizontal floor/ ceiling transitions.
- F. Vertical – Wall-to-Wall (**EJ-4**):
 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWF-200
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- G. Vertical – Wall-to-Corner with Fire Barrier (**EJ-5**):
 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWFC-200 with Fire Barrier
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- H. Horizontal – Ceiling-to-Ceiling (**EJ-6**):
 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWF-200
 - 3) Color: White
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.

- c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- I. Horizontal – Ceiling-to-Wall (**EJ-7**):
- 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWFC-200
 - 3) Color: White
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- J. Vertical – Wall-to-Wall (**EJ-8**):
- 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWF-200 with fire barrier
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- K. Horizontal – Ceiling-to-Ceiling (**EJ-9**):
- 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWF-200 with fire barrier
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- L. Horizontal – Floor-to-Floor/Floor-to-Wall (**EJ-10**):

1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Exterior Model HF-200 with 2" Allway Standard Metal floor Cover Model PCW-200 and 2" Allway Standard Metal Floor Cover Model PC-200.
 - 3) Color: Gray/Clear Anodized
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.

2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and blockouts where architectural joint systems will be installed for installation tolerances and other conditions affecting performance of work.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to architectural joint system manufacturer's written instructions.
- B. Repair concrete slabs and blockouts using manufacturer's recommended repair grout of compressive strength adequate for anticipated structural loadings.
- C. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.
- D. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing architectural joint assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install joint systems.
 - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper joint installation and performance.
 - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 - 4. Locate in continuous contact with adjacent surfaces.
 - 5. Heavy-Duty Systems: Repair or grout blockout as required for continuous frame support and to bring frame to proper level. Shimming is not allowed.
 - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
- C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both frame interfaces before installing compression seals.
- E. Foam Seals: Install with adhesive recommended by manufacturer.
- F. Epoxy-Bonded Seals: Pressurize seal for time period and to pressure recommended by manufacturer. Do not overpressurize.
- G. Terminate exposed ends of joint assemblies with field- or factory-fabricated termination devices.
- H. Fire-Resistance-Rated Assemblies: Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.
 - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- I. Water Barrier: Provide water barrier at exterior joints and where called for on Drawings.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION 079500

SECTION 079501 – INTERIOR EXPANSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior architectural joint systems.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for cast-in architectural-joint-system frames furnished, but not installed, in this Section.
 - 2. Division 04 Section "Unit Masonry" for masonry wall joint systems.
 - 3. Division 07 Section "Exterior Expansion Control " for exterior joint expansion control.
 - 4. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal wall joint systems.

1.3 DEFINITIONS

- A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage (plus or minus) of nominal value of joint width.
- D. Nominal Joint Width: The width of the linear opening specified in practice and in which the joint system is installed.

1.4 SUBMITTALS

- A. Shop Drawings: Provide the following for each joint system specified:
 - 1. Placement Drawings: Include line diagrams showing plans, elevations, sections, details, splices, blockout requirement, entire route of each joint system, and attachments to other work. Where joint systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

2. Architectural Joint System Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - a. Manufacturer and model number for each joint system.
 - b. Joint system location cross-referenced to Drawings.
 - c. Nominal joint width.
 - d. Movement capability.
 - e. Classification as thermal or seismic.
 - f. Materials, colors, and finishes.
 - g. Product options.
 - h. Fire-resistance ratings.
- B. Samples for Verification: For each type of architectural joint system indicated.
 1. Full width by 6 inches long, for each system required.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for current products.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated. Refer to Division 01 Section "Product Requirements."
 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Accessibility Requirements: Comply with applicable provisions in [the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and ICC A117.1.
- E. Fire-Test-Response Characteristics: Where indicated, provide architectural joint system and fire-barrier assemblies identical to those of assemblies tested for fire resistance per UL 2079 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies shall be subjected to hose stream testing.

1.6 COORDINATION

- A. Coordinate installation of exterior wall and soffit joint systems with roof expansion assemblies to ensure that wall transitions are watertight. Roof expansion assemblies are specified in Division 07.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.
 - 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
 - 2. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- B. Elastomeric Seals: Preformed elastomeric membranes or extrusions to be installed in metal frames.
- C. Compression Seals: ASTM E 1612; preformed rectangular elastomeric extrusions having internal baffle system and designed to function under compression.
- D. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required rating period.
- E. Moisture Barrier: Flexible elastomeric material, PVC, minimum 30 mils thick.
- F. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.2 ARCHITECTURAL JOINT SYSTEMS, GENERAL

- A. General: Provide architectural joint systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
 - 1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where joint changes direction or abuts other materials.
 - 2. Include factory-fabricated closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
- B. Design architectural joint systems for the following size and movement characteristics:
 - 1. Nominal Joint Width: As indicated on Drawings.
 - 2. Movement Capability: Plus or minus 50 percent.
 - 3. Type of Movement: Thermal.

2.3 ARCHITECTURAL JOINT SYSTEMS FOR BUILDING INTERIORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
 2. Balco, Inc.
 3. Construction Specialties, Inc.
 4. JointMaster/InPro Corporation.
 5. MM Systems Corporation.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- C. Horizontal – Floor-to-Wall (**EJ-1**):
1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model GFTW-200
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- D. Horizontal – Floor-to-Floor (**EJ-2**):
1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model GFT-200
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- E. Vertical – Wall-to-Corner (**EJ-3**):
1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWFC-200M

- 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and horizontal floor/ ceiling transitions.
- F. Vertical – Wall-to-Wall (**EJ-4**):
 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWF-200
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- G. Vertical – Wall-to-Corner with Fire Barrier (**EJ-5**):
 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWFC-200 with Fire Barrier
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- H. Horizontal – Ceiling-to-Ceiling (**EJ-6**):
 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWF-200
 - 3) Color: White
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.

- c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
 - I. Horizontal – Ceiling-to-Wall (**EJ-7**):
 - 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWFC-200
 - 3) Color: White
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- J. Vertical – Wall-to-Wall (**EJ-8**):
 - 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWF-200 with fire barrier
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- K. Horizontal – Ceiling-to-Ceiling (**EJ-9**):
 - 1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Thinline flush floor cover Model FWF-200 with fire barrier
 - 3) Color: Gray
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.
- L. Horizontal – Floor-to-Floor/Floor-to-Wall (**EJ-10**):

1. Basis-of-Design Product:
 - a. As indicated on Drawings.
 - 1) Manufacturer: Construction Specialties, Inc.
 - 2) Model: 2" Exterior Model HF-200 with 2" Allway Standard Metal floor Cover Model PCW-200 and 2" Allway Standard Metal Floor Cover Model PC-200.
 - 3) Color: Gray/Clear Anodized
 - 4) Nominal Joint Width: As scheduled.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
 - c. Provide manufacturer recommended accessories to maintain closure at corners and vertical transitions.

2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and blockouts where architectural joint systems will be installed for installation tolerances and other conditions affecting performance of work.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to architectural joint system manufacturer's written instructions.
- B. Repair concrete slabs and blockouts using manufacturer's recommended repair grout of compressive strength adequate for anticipated structural loadings.
- C. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.
- D. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing architectural joint assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install joint systems.
 - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper joint installation and performance.
 - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 - 4. Locate in continuous contact with adjacent surfaces.
 - 5. Heavy-Duty Systems: Repair or grout blockout as required for continuous frame support and to bring frame to proper level. Shimming is not allowed.
 - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
- C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both frame interfaces before installing compression seals.
- E. Foam Seals: Install with adhesive recommended by manufacturer.
- F. Epoxy-Bonded Seals: Pressurize seal for time period and to pressure recommended by manufacturer. Do not overpressurize.
- G. Terminate exposed ends of joint assemblies with field- or factory-fabricated termination devices.
- H. Fire-Resistance-Rated Assemblies: Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.
 - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- I. Water Barrier: Provide water barrier at exterior joints and where called for on Drawings.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION 079501

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

- D. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Amweld International, LLC.
 2. Apex Industries, Inc.
 3. Ceco Door Products; an Assa Abloy Group company.
 4. Commercial Door & Hardware Inc.
 5. Curries Company; an Assa Abloy Group company.
 6. Republic Doors and Frames.
 7. Steelcraft; an Ingersoll-Rand company.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Uncoated steel sheet cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 - 3. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Construction: Full profile welded.
 - 4. Exposed Finish: Prime.
 - 5. Fire ratings: Provide fire-rated door and frame assemblies as required.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.
 - 1. Physical Performance: Level A according to SDI A250.4.

2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm.)
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.
3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
 - b. Construction: Full profile welded.
4. Exposed Finish: Prime.
5. Fire ratings: Provide fire-rated door and frame assemblies as required.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- H. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- J. Glazing: Comply with requirements in Section 08 glazing sections.
- K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 - 2. Fire Door Cores: As required to provide fire-protection ratings indicated.
 - 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).

4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - c. Compression Type: Not less than two anchors in each frame.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
 6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

- b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- 7. Terminated Stops: Terminate stops 6 inches (152 mm) above finish floor with a 90-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow-metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

- A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.
 - 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
- B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 7. In-Place Metal: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
 - c. At Bottom of Door: [3/4 inch (19.1 mm)] [5/8 inch (15.8 mm)] plus or minus 1/32 inch (0.8 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 08 glazing sections and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.
- ### 3.4 ADJUSTING AND CLEANING
- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
 - B. Remove grout and other bonding material from hollow-metal work immediately after installation.

- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Solid-core doors with wood-veneer faces.
- 2. Factory finishing flush wood doors.
- 3. Factory fitting flush wood doors to frames and factory machining for hardware.

- B. Related Sections:

- 1. Division 06 Section "Interior Architectural Woodwork" for requirements for veneers from the same flitches for both flush wood doors and wood paneling.
- 2. Division 08 glazing sections for glass view panels in flush wood doors.

1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, and trim for openings. Include factory-finishing specifications.

- B. LEED Submittals:

- 1. Certificates for Credit MR 7: Chain-of-custody certificates certifying that flush wood doors comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
 - a. Include statement indicating costs for each certified wood product.
- 2. Product Data for Credit EQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.

- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

- 1. Indicate dimensions and locations of mortises and holes for hardware.
- 2. Indicate dimensions and locations of cutouts.
- 3. Indicate requirements for veneer matching.
- 4. Indicate doors to be factory finished and finish requirements.
- 5. Indicate fire-protection ratings for fire-rated doors.

- D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.
 - a. Provide samples for each species of veneer and solid lumber required.
 - b. Finish veneer-faced door samples with same materials proposed for factory-finished doors.
3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

E. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Source Limitations: Obtain flush wood doors and wood paneling from single manufacturer.
- C. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10B.
 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
 2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Algoma Hardwoods, Inc.
 2. Buell Door Company.
 3. Chappell Door Co.
 4. Eggers Industries.
 5. Graham; an Assa Abloy Group company.
 6. Marshfield Door Systems, Inc.
 7. Mohawk Flush Doors, Inc.; a Masonite company.
 8. VT Industries Inc.

2.2 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
1. Grade: Premium, with Grade AA faces.
 2. Species: Select white maple.
 3. Cut: Quarter sliced.
 4. Match between Veneer Leaves: Slip match.
 5. Assembly of Veneer Leaves on Door Faces: Balance match.
 6. Pair and Set Match: Provide for doors hung in same opening.
 7. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
 8. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Division 06 Section "Interior Architectural Woodwork."
 9. Exposed Vertical and Top Edges: Same species as faces.
 10. Core: Either glued or nonglued wood stave or structural composite lumber.
 11. Construction: Seven plies, either bonded or nonbonded construction.

2.3 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
 - 1. Wood Species: Same species as door faces.
 - 2. Profile: Manufacturer's standard shape.
 - 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Cut and trim openings through doors in factory.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."
 - 3. Louvers: Factory install louvers in prepared openings.

2.5 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory.
- C. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
- D. Transparent Finish:

1. Grade: Premium.
2. Finish: AWI conversion varnish system.
3. Staining: As selected by Architect from manufacturer's full range.
4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Access doors and frames for walls and ceilings.
- B. Related Sections include the following:
 - 1. Division 04 Section "Unit Masonry" for anchoring and grouting access door frames set in masonry construction.
 - 2. Division 07 Section "Roof Accessories" for roof hatches.
 - 3. Division 08 Section "Door Hardware" for mortise or rim cylinder locks and master keying.
 - 4. Division 09 Section "Acoustical Panel Ceilings" for suspended acoustical tile ceilings.

1.3 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.
- D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
- E. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.
- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following

test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for vertical access doors and frames.
2. ASTM E 119 or UL 263 for horizontal access doors and frames.

- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Steel Sheet: Uncoated or electrolytic zinc-coated, ASTM A 591/A 591M with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS) with A60 (ZF180) zinc-iron-alloy (galvannealed) coating or G60 (Z180) mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.
- D. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 2. Surface Preparation for Metallic-Coated Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
 - a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
 3. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.
- E. Drywall Beads: Edge trim formed from 0.0299-inch (0.76-mm) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acudor Products, Inc.
 2. Babcock-Davis; A Cierra Products Co.
 3. Dur-Red Products.
 4. J. L. Industries, Inc.
 5. Karp Associates, Inc.
 6. Milcor Inc.
 7. Nystrom, Inc.
- B. Flush Access Doors and Frames with Exposed Trim: Fabricated from metallic-coated steel sheet.
1. Locations: Masonry wall surfaces.
 2. Door: Minimum 0.0598-inch- (1.52-mm.) thick sheet metal, set flush with exposed face flange of frame.
 3. Frame: Minimum 0.0625-inch- (1.58-mm.) thick sheet metal with 1-1/4-inch- (32-mm.) wide, surface-mounted trim.
 4. Hinges: Spring-loaded, concealed-pin type.
 5. Latch: Self-latching bolt operated by flush key with interior release.
 6. Lock: Cylinder.
 7. Finish: Baked enamel, factory finished.
- C. Flush Access Doors and Trimless Frames: Fabricated from metallic-coated steel sheet.
1. Locations: Gypsum board wall surfaces.
 2. Door: Minimum 0.0598-inch- (1.52-mm.) thick sheet metal, set flush with surrounding finish surfaces.
 3. Frame: Minimum 0.0625-inch- (1.58-mm.) thick sheet metal with drywall bead flange.
 4. Hinges: Spring-loaded, concealed-pin type.
 5. Latch: Flush key with interior release.
 6. Lock: Cylinder.
 7. Finish: Baked enamel, factory finished.
- D. Fire Rated, Uninsulated, Flush Access Doors and Frames with Exposed Trim: Fabricated from metallic-coated steel sheet.
1. Locations: Fire rated wall surfaces.
 2. Fire-Resistance Rating: Not less than that of adjacent construction.
 3. Door: Minimum 0.0598-inch- (1.52-mm-) thick sheet metal, flush construction.
 4. Frame: Minimum 0.0625-inch- (1.58-mm-) thick sheet metal with 1-1/4-inch- (32-mm.) wide, surface-mounted trim.
 5. Hinges: Concealed-pin type.
 6. Automatic Closer: Spring type.
 7. Latch: Self-latching device operated by flush key with interior release.
 8. Lock: Self-latching device with cylinder lock.
 9. Finish: Baked enamel, factory finished.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 - 1. Exposed Flanges: Nominal 1 to 1-1/2 inches (25 to 38 mm) wide around perimeter of frame.
 - 2. Provide mounting holes in frame for attachment of masonry anchors. Furnish adjustable metal masonry anchors.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder lock, furnish two keys per lock and key all locks alike.
- F. Extruded Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-rated service doors with integral pass doors.
- B. Related Sections:
 - 1. Division 05 "Metal Fabrications" for miscellaneous steel supports.
 - 2. Division 09 painting sections for finish painting of factory-primed doors.
 - 3. Division 26 electrical sections.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
 - 1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 - 3. For fire-rated doors, description of fire-release system including testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Show locations of replaceable fusible links.
 - 3. Wiring Diagrams: For power, signal and control wiring.

- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Curtain Slats: 12 inches (305 mm) long.
 - 2. Bottom Bar: 6 inches (150 mm) long.
 - 3. Guides: 6 inches (150 mm) long.
 - 4. Brackets: 6 inches (150 mm) square.
 - 5. Hood: 6 inches (150 mm) square.
 - 6. Laminate-Clad Counter Panel Product: 6 inches (150 mm) square; for each type, color, pattern, and surface finish; laminated to core.
- E. Delegated-Design Submittal: For overhead coiling doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Summary of forces and loads on walls and jambs.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.
- C. Certifications:
 - 1. Submit manufacturer's Underwriters Laboratories (UL), Warnock Hersey (WH) or Factory Mutual Research (FM) laboratory test report verifying product compliance in accordance with the required fire and smoke ratings.
 - 2. Provide manufacturer's ICC Evaluation Service report confirming compliance of the fire door assembly in accordance with the requirements of the Building Code.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling door manufacturer.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 2. Smoke Control: In corridors and smoke barriers, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. (0.01524 cu. m/s x sq. m) of door opening at 0.10 inch wg (24.9 Pa) for both ambient and elevated temperature tests.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

PART 2 - PRODUCTS

2.1 COILING FIRE & SMOKE RATED DOORS WITH INTEGRAL EGRESS DOOR

- A. Basis-of-Design Products: Subject to compliance with requirements, provide the named product or comparable products for the fire and smoke rated coiling door with integral egress doors:
1. Basis of Design Manufacturer: McKeon Door Company
 - a. Model: Safescape, T2000-PC
- B. Curtain: Shall be assembled of interlocking galvanized steel slats, cold rolled. Slats shall have endlocks locking each end of alternate slats to act as a wearing surface, and maintain slat alignment. Curtain shall be 22 gauge minimum or gauge required by UL, WH or FM which ever is greater.
1. Slats: Shall be of a cross section not less than 3" wide by 7/8" deep.
- C. Bottom Bar: Shall consist of two (2) angles, each not less than 2" x 2" x 1/8" steel formed to fit slats. Bottom bar shall be provided with slotted holes to allow for thermal expansion.
- D. Swinging Egress Door: Incorporated within the curtain shall be a swinging type steel door designed and built as an integral part of the fire door's assembly.
1. Door Frame: Shall be an all-steel unit type ASTM A366 hot rolled steel, 14 gauge with the same labeled fire resistance rating as specified for door.
 2. Door Assembly: Complete with door, hinge, and locking channel mechanism. 20 gauge stretcher leveled, electro galvanized and bonderized steel faces.
 3. Hardware:
 - a. Fire Exit Device: Flush mounted integral type fire exit device on one face and with pull handle on opposite face of the swinging door.
 - b. Closer: Shall be surface mounted 180 degree pocketed application.
 - c. Electro Magnetic Door Holder: Shall be surface mounted with proper projection to hold swinging door in the fully open position.
- E. Guides: Each guide assembly shall be fabricated of a minimum 4" x 4" steel support tube and two curtain guide angles fabricated of 1/8" thick minimum steel bent shapes with a minimum 3-1/2" depth. Support tubes shall be constructed with a slip joint at the top to provide for thermal expansion and guide angles shall be provided with slotted holes to allow for thermal expansion.

1. Provide internal UL classified smoke seals in each guide assembly. Assembly shall have been tested and approved under UBC 7-2-1997 Part II.
- F. Floating Guide: Each curtain shall incorporate a steel channel assembly to ensure proper feeding of the curtain into the door frames. This assembly shall also allow for the engagement of coiling curtain into the egress door frame.
- G. Mounting Brackets: Fabricated of hot rolled 3/16" steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.
- H. Hood: Shall be provided to entirely enclose curtain and counterbalance barrel assembly. Hood shall be fabricated 22 gauge galvanized steel and designed to match brackets. Top and bottom shall be bent and reinforced for stiffness.
1. Provide UL approved lintel smoke seals. Assembly shall have been tested and approved under UBC 7-2-1997 Part II.
- I. Counterbalance Assembly: Door shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.
- J. Electric Motor Operator: Fire door shall be provided with a compact power unit designed and built by the door manufacturer. Operator shall be equipped with an adjustable screw-type limit switch to break the circuit at termination of travel. High efficiency planetary gearing running in an oil bath, shall be furnished together with a centrifugal governor, magnetic operated brake and a fail-safe magnetic release device, completely housed to protect against damage, dust and moisture. An efficient overload protection device, which will break the power circuit and protect against damage to the motor windings shall be integral with the unit. Operator is to be housed in a NEMA type 1 enclosure.
- K. Motor: Shall be intermediate duty, thermally protected, ball bearing type with a class A or better insulation. Horsepower of motor is to be 1/3hp minimum or of manufacturer's recommended size, which ever is greater.
1. Starter: Shall be size "0" magnetic reversing starter, across the line type with mechanical and electrical interlocks, with 10 amp continuous rating and 24 volt control circuit.
 2. Reducer: Planetary gear type, 80% efficiency minimum.
 3. Brake: Magnetically activated, integral within the operator's housing.
 4. Control Station: Provide flush mount key switch control station marked open, close and stop.
- L. Self-Closing Mechanism: The fire door is to be designed with a centrifugal governor as an integral part of the operator's construction. The automatic release mechanism shall be activated by a fusible link, smoke detector or fire alarm. When activated the egress door and frame is released to the closed position, ten seconds later the coiling curtain is released and begins to close due to gravitational force. The speed of the curtain is governed by a centrifugal governor, designed to match the normal operating speed of the door, at a rate of not greater than 9" per second or less than 6" per second.
- M. Magnetic Release with 10 Second Time Delay: A fail-safe magnetic release device shall be built into the operator as an integral part of the release mechanism. When power is interrupted to the release mechanism by the smoke detector or fire alarm, the door shall begin to self-close. In the event of power failure the time delay shall prevent the coiling curtain from closing for a period of 10 seconds. Once the 10 seconds have lapsed, the coiling curtain shall self-close. Once power has been restored to the release mechanism the automatic reset time delay as well as the fire door shall automatically reset themselves.

- N. Obstruction Sensing Safety Edge: The coiling curtain shall be designed with an obstruction sensing safety edge. In the event that the safety edge meets an obstruction during the normal closing operation, the door shall stop, reverse and return to the open position. In the event the safety edge meets an obstruction during the self-closing operation, the door shall come to rest on the obstruction and once the obstruction has been removed the fire door shall continue to the fully closed position.
- O. Easy Trip Test Feature: The fire door shall be designed so that it may be trip tested simply by cutting power to the operator. By turning the power switch off, the door shall self-close. Once the fire door has satisfactorily closed, it shall be reset simply by turning the power back on. No ladders or tools shall be needed to reset the door or the time delay unit.
- P. Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for powder coat adhesion. Provide powder coat finish of color as selected by architect from manufacturer's standard RAL powder coat selection chart.

2.2 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with smoke-seal perimeter gaskets for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
 - 1. Provide pull-down straps or pole hooks for doors more than 84 inches (2130 mm) high.
- C. Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automatic-closing device that is inoperative during normal door operations and that has a governor unit complying with NFPA 80 and an easily tested and reset release mechanism designed to be activated by the following:
 - 1. Replaceable fusible links with temperature rise and melting point of 165 deg F (74 deg C) interconnected and mounted on both sides of door opening.
 - 2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
 - 3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.
 - 4. Building fire-detection and -alarm systems and manufacturer's standard door-holder-release devices.

2.3 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.4 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.
- B. Door Operator Location(s): Operator location indicated for each door.
 - 1. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
- C. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 110513 "Common Motor Requirements for Equipment" unless otherwise indicated.
 - 1. Electrical Characteristics:
 - a. Phase: Single phase.
 - b. Volts: 120 V.
 - 2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
 - 3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
 - 4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- D. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- E. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. For fire-rated doors, activation delays closing.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

- a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
2. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
- F. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
 1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 2. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- G. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).
- H. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- I. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- J. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Fire-Rated Doors: Install according to NFPA 80.
- E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide weathertight fit around entire perimeter.
- D. Install wiring in accordance with applicable local codes and the National Electrical Code Standard. Materials shall be UL listed.
- E. Test door closing sequence when activated by the building's fire alarm system. Reset door after successful test.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Exterior storefront framing.
- 2. Manual-swing entrance doors and door-frame units.

- B. Related Sections:

- 1. Division 08 Section "Glazed Aluminum Curtain Walls" for curtain-wall systems that mechanically retain glazing on four sides.

1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units.

- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
- D. Deflection of Framing Members:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than 1/8 inch and clearance between members and operable units directly below them to less than 1/16 inch.
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- F. Story Drift: Provide aluminum-framed systems that accommodate design displacement of adjacent stories indicated.
 - 1. Design Displacement: As indicated on Drawings.
 - 2. Test Performance: Meet criteria for passing, based on building occupancy type, when tested according to AAMA 501.4 at design displacement and 1.5 times design displacement.
- G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. () of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..
- H. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- I. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
 - 1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed

systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.

- J. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
 - 2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
 - b. Low Exterior Ambient-Air Temperature: 0 deg F.
 - 3. Interior Ambient-Air Temperature: 75 deg F.
- K. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 60 when tested according to AAMA 1503.
- L. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.46 when tested according to AAMA 1503.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside of the weatherproofing system, documentation including printed statement of VOC content.
- C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 - 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- F. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of aluminum-framed systems.
 2. Include design calculations.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Warranties: Sample of special warranties.
- 1.7 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- 1.8 QUALITY ASSURANCE
- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- D. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall area as shown on Drawings.
 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures including, but not limited to, excessive deflection.
- b. Noise or vibration caused by thermal movements.
- c. Deterioration of metals and other materials beyond normal weathering.
- d. Water leakage through fixed glazing and framing areas.
- e. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: Five (5) years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

- A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Contractor's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308/B 308M.
 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.2 FRAMING SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide YKK AP America, Inc. YES 45 TU, or comparable product by one of the following:
1. Kawneer North America; an Alcoa company.
 2. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
 3. Special Lite, Inc.
- B. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally broken 2 by 4 - 1/2 inches.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front.
 4. Provide keyed, lockable, removable, vertical mullion between pairs of door leaves.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
- E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel

inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

- F. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.
- G. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
 - 1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.4 ENTRANCE DOOR SYSTEMS

- A. Subject to compliance with requirements, provide Special-Lite, Inc., Monumental Wide Stile Door SL-15. Substitutions are not permitted by Contractor.
- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 - 1. Door Construction: 2- to 2-1/4-inch overall thickness, with minimum 0.125-inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design:
 - a. Wide Stile
 - 1) Stile Width: 4 3/4 inch
 - 2) Top Rail: 6-1/2 inch
 - 3) Mid Rail: 4 inch
 - 4) Bottom Rail: 10 inch
 - b. True mortise and tenon joints
 - c. Full Width 3/8 inch diameter galvanized steel tie rods secured with locking hex nuts.
 - d. Welding of joints: Not permitted.
 - e. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
 - 3. Finish: Match finish of storefront.
 - 4. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - 5. Provide manufacturer's Applied Glass Stop Framing System and other

accessories and components necessary for construction, installation, and operation.

2.5 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
 - 1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by de-scaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles which are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from exterior.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using shear-block system.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
 - 2. At exterior doors, provide compression weather stripping at concealed top and bottom fittings.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.

2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- 2.7 ALUMINUM FINISHES
- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, (0.018 mm) or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
1. Comply with manufacturer's written instructions.
 2. Do not install damaged components.
 3. Fit joints to produce hairline joints free of burrs and distortion.
 4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Division 08 Section "Glazing."
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- H. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections.
- B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft., of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..
 - a. Test Area: One bay wide, but not less than 30 feet, by one story of glazed aluminum curtain wall. Test area shall include the full wall assembly and accessories including head, jamb, and sill flashings, air barrier, and joint sealants.
 - b. Perform a minimum of two tests in areas as directed by Architect.
 2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under "Performance Requirements" Article, but not less than 4.18 lbf/sq. ft., and shall not evidence water penetration.

- a. Test Area: One bay wide, but not less than 30 feet, by one story of glazed aluminum curtain wall. Test area shall include the full wall assembly and accessories including head, jamb, and sill flashings, air barrier, and joint sealants.
 - b. Perform a minimum of two tests in areas as directed by Architect.
- C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.
- 3.5 ADJUSTING
- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
- 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

END OF SECTION 084113

SECTION 084116 – INTERIOR ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Interior storefront framing.

- B. Related Sections:

- 1. Section 081416 "Flush Wood Doors" for wood doors installed in aluminum frames.
- 2. Section 084113 "Aluminum-Framed Entrances and Storefronts" for exterior aluminum-framed entrances and storefronts.
- 3. Section 084413 "Glazed Aluminum Curtain Walls" for curtain-wall systems that mechanically retain glazing on four sides.

1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

- 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
- 2. Dimensional tolerances of building frame and other adjacent construction.
- 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Glazing-to-glazing contact.
 - e. Noise or vibration created by wind and by thermal and structural movements.
 - f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Sealant failure.
 - h. Failure of operating units.

- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads: As indicated on drawings.
- D. Deflection of Framing Members:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than 1/8 inch (3.2 mm) and clearance between members and operable units directly below them to less than 1/16 inch (1.5 mm).
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a test pressure differential of 10 psf (479 Pa).
- H. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside of the weatherproofing system, documentation including printed statement of VOC content.
- C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Other Action Submittals:
1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- F. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of aluminum-framed systems.
 2. Include design calculations.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Warranties: Sample of special warranties.
- 1.7 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- 1.8 QUALITY ASSURANCE
- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

- D. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals and other materials beyond normal weathering.
 - d. Adhesive or cohesive sealant failures.
 - e. Water leakage through fixed glazing and framing areas.
 - f. Failure of operating components.
 - 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide YKK AP America, Inc. "YES 45 FI" framing system or comparable product by one of the following:

1. Kawneer North America; an Alcoa company.
2. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
3. Special Lite, Inc.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308/B 308M.
 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Nonthermal, 2" x 4 1/2".
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Center.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Adapters: provide manufacturer's standard adapters as required for glazing indicated.

2.5 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 "Joint Sealants."
 - 1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from exterior.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using shear-block system.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 1. Comply with manufacturer's written instructions.
 2. Do not install damaged components.
 3. Fit joints to produce hairline joints free of burrs and distortion.
 4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- E. Install glazing as specified in Section 088000 "Glazing."
- F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

- G. Install perimeter joint sealants as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections.
- B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
 - 1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. (0.03 L/s per sq. m), of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 084116

SECTION 084123 – FIRE-RATED ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Fire-rated glazing and framing systems for installation as wall sections in interior openings.
- B. Related Sections:
 - 1. Section 05 12 00 "Structural Steel Framing:" Steel attachment members
 - 2. Section 05 50 00 "Metal Fabrications:" Steel attachment members inserts and anchors.
 - 3. Section 078413 "Penetration Firestopping:" Firestops between work of this section and other fire resistive assemblies.
 - 4. Section 081113 "Hollow Metal Doors and Frames." Hollow Metal doors prepped for the work of this section.
 - 5. Section 081416 "Flush Wood Doors" for wood doors prepped for the work of this section.
 - 6. Section 087100 "Door Hardware:" Door hardware other than that provided by the work of this section

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM E119: Methods for Fire Tests of Building Construction and Materials.
 - 2. ASTM E2074-00: Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.
 - 3. ASTM E2010-01: Standard Test Method for Positive Pressure Fire Tests of Window Assemblies.
 - 4. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2007.
 - 5. ASTM A 1011/A 1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2006b.
- B. American Welding Society (AWS)
 - 1. AWS D1.3 - Structural Welding Code - Sheet Steel; 2007
- C. Builders Hardware Manufacturers Association, Inc
 - 1. BHMA A156 - American National Standards for door hardware; 2006 (ANSI/BHMA A156).

- D. National Fire Protection Association (NFPA):
 - 1. NFPA 80: Fire Doors and Windows.
 - 2. NFPA 251: Fire Tests of Building Construction & Materials
 - 3. NFPA 252: Fire Tests of Door Assemblies
 - 4. NFPA 257: Fire Test of Window Assemblies

- E. Underwriters Laboratories, Inc. (UL):
 - 1. UL 9: Fire Tests of Door Assemblies
 - 2. UL 10 B: Fire Tests of Door Assemblies
 - 3. UL 10 C: Positive Pressure Fire Tests of Window & Door Assemblies
 - 4. UL 263: Fire tests of Building Construction and Materials
 - 5. UL-752 Ratings of Bullet-Resistant Materials

- F. American National Standards Institute (ANSI):
 - 1. ANSI Z97.1: Standard for Safety Glazing Materials Used in Buildings

- G. Consumer Product Safety Commission (CPSC):
 - 1. CPSC 16 CFR 120: Safety Standard for Architectural Glazing Materials

- H. American Society of Civil Engineers (ASCE)
 - 1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures; 2005

1.4 PERFORMANCE REQUIREMENTS

- A. Fire Rating Requirements
 - 1. Duration – Doors: Capable of providing a fire rating for 90 minutes.
 - 2. Duration – Windows Capable of providing a fire rating for 120 minutes.
 - 3. Duration – Walls: Capable of providing a fire rating for 120 minutes.

- B. Delegated design: For the performance requirements listed below requiring structural design provide data, calculations and drawings signed and sealed by an engineer licensed in the state where the project is located.

- C. Structural Performance
 - 1. Design and size the system to withstand structural forces placed upon it without damage or permanent set when tested in accordance with ASTM E330 using load 1.5 times the design wind loads and of 10 seconds in duration.
 - 2. Structural loads: As indicated on the drawings.
 - 3. Member deflection: Limit deflection of the edge of the glass normal to the plane of the glass to [flexure limit of glass][1/175 of the glass edge length or 3/4 inch, whichever is less][of any framing member
 - 4. Accommodate movement between storefront and adjoining systems

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, fire-resistance rating, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 2. Locations of reinforcements and preparations for hardware.
 - 3. Details of each different wall-opening condition.
 - 4. Details of anchorages, joints, field splices, and connections.
 - 5. Details of accessories.
 - 6. Details of moldings, removable stops, and glazing.
 - 7. Details of conduits and preparations for power, signal, and control systems.
- C. Samples for Verification: For interior aluminum frames, prepared on Samples of size indicated below:
 - 1. Framing Member: 12 inches (300 mm) long.
 - 2. Corner Fabrication: 12-by-12-inch- (300-by-300-mm-) long, full-size window corner, including full-size sections of extrusions with factory-applied color finish.
- D. Schedule: For interior aluminum frames. Use same designations indicated on Drawings. Coordinate with door hardware schedule and glazing.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of interior aluminum frame.
- B. Installer Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Certification: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- D. Warranties: Submit manufacturer's warranty and ensure that forms have been completed in the Owner's name and registered with the manufacturer.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-rated interior aluminum frames to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire-rated interior aluminum frames from single source from single manufacturer.

- B. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).
 - C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by UL, for fire ratings indicated, based on testing according to NFPA 252. Door assembly must be factory-welded or come complete with factory-installed mechanical joints and must not require job site fabrication.
 - D. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by UL, for fire ratings indicated, based on testing according to NFPA 257, ASTM E119.
 - E. Door assemblies shall be marked with the hourly rating followed by the letter "S". The letter "S" indicates air leakage resistance testing conformance to UBC 7-2 Parts I and II.
 - F. Regulatory Requirements: Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)" and ANSI A117.1 as follows:
 - 1. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - 2. Door Closers: Comply with the following maximum opening-force requirements indicated: Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than 15 lbf (67 N) to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Door Closers: Not more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.
 - G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area in location as directed by Architect.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 - H. Preinstallation Conference: Conduct conference at Project site.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Deliver fire-rated interior aluminum frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Examine units immediately upon delivery and report any damage immediately.
 - 2. Do not store horizontally.
 - 3. Place glass and frames upright, no less than 6 degrees from vertical.
 - 4. Store all materials in dry conditions, off the ground.
 - 5. Protect from construction activities.
 - 6. Fully support Glass units along entire length

7. Non-abrasive pads such as cloth or cork must separate glass and frame units.
8. Do not stack containers.

1.10 PROJECT CONDITIONS

- A. Obtain field measurements prior to fabrication of frame units. If field measurements will not be available in a timely manner coordinate planned measurements with the work of other sections.
 1. Note whether field or planned dimensions were used in the creation of the shop drawings.

1.11 WARRANTY

- A. Provide manufacturer's standard five year warranty from the date of shipment from the factory.

PART 2 - PRODUCTS

2.1 MANUFACTURERS – FIRE-RATED ALUMINUM FRAMED WALL ASSEMBLY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide : "Fireframes® Aluminum Series" fire-rated frame system as manufactured and supplied by Technical Glass Products with "Pilkington Pyrostop®" fire-rated glazing as manufactured by the Pilkington Group and distributed by Technical Glass Products, or comparable product by one of the following:
 1. SaftiFirst Fire Rated Glazing Solutions.
 2. Alufam North America.

2.2 MATERIALS - GLASS

- A. Fire Rated Glazing: ASTM C 1036 and ASTM C 1048; composed of multiple sheets of Pilkington Optiwhite™ high visible light transmission glass laminated with an intumescent interlayer.
- B. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
- C. Thickness of Glazing Material: Pilkington Pyrostop® 120 minute, 57mm, 2 1/4"
- D. Approximate Visible Transmission: 75 to 88 percent.
- E. Logo: Each piece of fire-rated glazing shall be labeled with a permanent logo including name of product, manufacture, testing laboratory (UL), fire rating period, safety glazing standards, and date of manufacture.
- F. Glazing Accessories: Manufacturer's standard compression gaskets, standoff, spacers, setting blocks and other accessories necessary for a complete installation.

2.3 MATERIALS – ALUMINUM FRAMING

- A. Aluminum Framing System 120 min.
1. Steel Frame — The steel framing members are made of two halves, nom. 1.9 in. wide (48.3 mm) with a nom. minimum depth of 1.38 in. (35 mm) with lengths cut according to glazing size.
 2. Aluminum Trim — Supplied with the steel framing members. Nom. 2 in. (50.8 mm) wide with a nom. depth of 1.54 in. (39 mm) with lengths cut according to glazing size.
 3. Stainless Steel Standoffs — Supplied with the steel framing members. Nom 5/16 in. (8 mm) diameter with a nom. minimum depth of 1 1/8 in. (28 mm) with depth adjusted to match Pilkington Pyrostop® Panel thickness.
 4. Stainless Steel Moment and Connecting Braces: — Supplied with the steel framing members. Nom 3/8 in. (10 mm) thick with a nom. minimum depth of 1 1/8 in. (28 mm) with depth adjusted to match Pilkington Pyrostop® Panel thickness.
 5. Framing Member Fasteners — Supplied with the steel framing members. Screws are M6 x16mm Button Head Socket Cap Screws for frame assembly and #6 x 1" Pan Head Sheet Metal Screws for door installation.
 6. Glazing Gasket — Supplied with the steel framing members. Nom. 3/4 in. (19 mm) by 3/16 in. (4.5 mm) black applied to the steel framing members to cushion and seal the glazing material when installed.

2.4 MATERIALS – DOORS

- A. Aluminum/glass doors: Manufacturer's standard single leaf or double leaf doors as indicated with manufacturer's standard hardware.
1. Coordinate manufacturer's hardware to match sets for type of hardware indicated in Section 087100 Hardware.
 2. Coordinate door hardware with cylinder specified in Section 087100 Hardware.
- B. Steel/Wood doors: As specified in Section 081113 Hollow Metal Doors and Frames and Section 081416 Flush Wood Doors.
1. Coordinate door hardware and installation with hardware specified in Section 087100 Hardware.

2.5 ACCESSORIES

- A. Fasteners: Aluminum, nonmagnetic, stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.
- B. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals.
- C. Glazing Gaskets: Manufacturer's standard extruded or molded plastic, to accommodate glazing thickness indicated.
- D. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.
- E. Hardware: Comply with requirements in Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)."

2.6 FABRICATION

- A. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted or mitered connections.
- B. Field glaze door and frame assemblies.
- C. Factory prepare steel or wood door assemblies field mounting of hardware
- D. Fabrication Dimensions: Fabricate fire rated assembly to field dimensions.
- E. Obtain reviewed Shop Drawings prior to fabrication.
- F. Factory prepare interior aluminum frames to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."
 - 1. Locate hardware as required by fire-rated label for assembly.
- G. Fabricate frames for glazing with removable stops to allow glazing replacement without dismantling frame.
- H. Fabricate components to allow secure installation without exposed fasteners.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and ceilings, with Installer present, for conditions affecting performance of the Work.
- B. Verify that wall thickness does not exceed standard tolerances allowed by throat size indicated.
- C. Notify Architect of any conditions which jeopardize the integrity of the proposed fire wall / door system.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install interior aluminum frames plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.
- B. Install fire-rated walls and doors in strict accordance with the approved shop drawings.
- C. Set frames accurately in position and plumbed, aligned, and securely anchored to substrates.
 - 1. At fire-protection-rated openings, install interior aluminum frames according to NFPA 80.

3.3 CLEANING

- A. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended by frame manufacturer and according to AAMA 609 & 610.
- B. Touch up marred frame surfaces. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 084123

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes conventionally glazed aluminum curtain walls installed as stick assemblies.
- B. Related Sections:
 - 1. Division 07 Section "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.

1.3 ALLOWANCES

- A. Provide field quality-control testing as part of testing and inspecting allowance.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Glazed aluminum curtain walls shall withstand movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- B. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
- D. Structural-Test Performance: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
 3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.
- F. Story Drift: Accommodate design displacement of adjacent stories indicated.
1. Design Displacement: As indicated on Drawings.
 2. Test Performance: Meeting criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.
- G. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft..
- H. Water Penetration under Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft..
1. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
- I. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
 2. Test Interior Ambient-Air Temperature: 75 deg F
 3. Test Performance: No buckling; stress on glass; sealant failure; excess stress

on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

- J. Energy Performance: Glazed aluminum curtain walls shall have certified and labeled energy performance ratings in accordance with NFRC.
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg Fas determined according to NFRC 100.
 2. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft.
 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC- certified condensation resistance rating of no less than 66 as determined according to NFRC 500.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 3. Include laboratory mockup Shop Drawings, prepared by a qualified preconstruction testing agency, showing details of laboratory mockup.
 - a. Resubmit Shop Drawings with changes made to glazed aluminum curtain walls to successfully complete preconstruction testing.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and testing agency.
- B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed aluminum curtain walls, indicating compliance with performance requirements.
- D. Field quality-control reports.
- E. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum curtain walls that meet or exceed energy performance requirements indicated and of documenting this performance by certification, labeling, and inclusion in lists.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- E. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
 - 1. Provide NFRC-certified glazed aluminum curtain walls with an attached label.
- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

G. Preinstallation Conference: Conduct conference at Project site.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Assembly Warranty: Standard form in which Installer agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures including, but not limited to, excessive deflection.
- b. Noise or vibration created by wind and thermal and structural movements.
- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- d. Water penetration through fixed glazing and framing areas.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
- b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements and to match systems used on Science Center and Science East projects, provide YKK AP America, Inc.:

1. System 1: YCW 750OG, with corresponding operable vents YCW 750CV.
2. System 2: YCW 750XT, triple glazed, thermal high performance profile with structural sealant glazed profiles at vertical members.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221, 6063-T5 and 6063-T6 aluminum alloy.
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308/B 308M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
- C. Thermal Barrier: [System 2] Provide MegaTherm® continuous thermal barrier by means of 6/6 nylon polyamide glass fiber reinforced pressure extruded bars.

2.3 FRAMING

- A. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally improved.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
- D. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or

steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

- E. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.
- F. Framing Sealants: Manufacturer's standard sealants.

2.4 GLAZING

- A. Glazing: Comply with Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.
 - 1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 INSULATED METAL SPANDREL PANELS

- A. Insulated Spandrel Panels: Drawing Designation - MSP1
 - 1. Prefabricated, laminated, fully insulated and fully sealed, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.
 - 2. Overall Panel Thickness: 1 inch.
 - 3. Exterior Skin: Formed with 0.020-inch thick, coil coated aluminum sheet.
 - 4. Exterior Finish: Mica fluoropolymer.
 - a. Color: To match color at Composite Wall Panel MP1: Titanium C-3100-DXLE.
 - 5. Interior Skin: Formed with 0.020-inch thick, coil coated aluminum sheet.
 - a. Finish: Mill finish.
 - b. Texture: Smooth.
 - 6. Thermal Insulation Core: Rigid, closed-cell, polyisocyanurate board or foam.

2.6 OPERABLE UNITS

- A. Venting Windows: Provide operable vents coordinated with curtain wall system and provided by same manufacturer. Basis of design is YKK AP America, Inc. YCW 750CV.
 - 1. Hardware: Standard heavy duty concealed stainless steel 4-bar hinges; with **custom** heavy duty multi-lock handles and strikes, pull handles and keepers in **custom stainless steel** finish.
- B. Doors: Comply with Division 08 Section "Aluminum-Framed Entrances and

Storefronts."

2.7 SOLAR SUNSHADE

- A. Solar Sunshades: Drawing Designation – Identified by types number 1-5.
- B. Basis-of-Design Product: Subject to compliance with requirements and to match systems used on Science Center project, provide YKK AP America, Inc.:
 - 1. ThermaShade system. Cradle-to-cradle certified solar shading devices fully integrated into curtain wall system with patented thermal barrier within the attachment anchor and comprised of outriggers, louvers, fascia, cover etc.
 - 2. Size: 36 inch.
 - 3. Outrigger: Aluminum square, extruded.
 - 4. Louver: Aluminum 6" ovoid.
 - 5. Fascia: Aluminum 2¼" x 5" channel, extruded.
 - 6. Cover: Provide optional aluminum mitered cover at curtain wall vertical framing members.
 - 7. Finish: YS1N Clear Anodized "Plus", AAMA 612, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.8 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles which are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- D. Curtain-Wall Framing: Fabricate components for assembly using shear-block system.
- E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

- A. Clear Anodic Finish: YS1N Clear Anodized "Plus", AAMA 612, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure non-movement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Division 08 Section "Glazing."

3.3 ERECTION TOLERANCES

- A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet 1/4 inch in 40 feet.
 - 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet

3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inchwide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inchwide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inchwide or more, limit offset from true alignment to 1/4 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inchover total length.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of representative areas of glazed aluminum curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.
 1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article, but not more than 0.50 cfm/sq. ft., of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft..
 - a. Test Area: One bay wide, but not less than 30 feet, by one story of glazed aluminum curtain wall. Test area shall include the full wall assembly and accessories including head, jamb, and sill flashings, air barrier, and joint sealants.
 - b. Perform a minimum of two tests in areas as directed by Architect.
 2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.
 - a. Test Area: One bay wide, but not less than 30 feet, by one story of glazed aluminum curtain wall. Test area shall include the full wall assembly and accessories including head, jamb, and sill flashings, air barrier, and joint sealants.
 - b. Perform a minimum of two tests in areas as directed by Architect.
- C. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084413

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes:

1. Commercial door hardware for the following:
 - a. Swinging doors.
 - b. Other doors to the extent indicated.
2. Electrified door hardware.

- B. Related Sections:

1. Division 08 Section "Hollow Metal Doors and Frames" for steel doors and frames including astragal requirements for pairs of doors.
2. Division 8 Section "Aluminum Frames" for interior aluminum frame requirements.
3. Division 08 Section "Flush Wood Doors" for wood doors including special stile and rail construction for application of hardware without through bolts.
4. Division 08 Section "Overhead Coiling Doors" for hardware requirements at coiling doors for the application of cylinders
5. Division 08 Section "Aluminum Entrances and Storefronts" for aluminum storefront door and frame requirements.
6. Division 26 Sections for electrical power system and line-voltage wiring work.
7. Division 28 Sections for access control devices installed at door openings provided as part of a security access system
8. Division 28 Sections for connections to building fire alarm system.

1.3 REFERENCES

- A. The publications listed below, including the amendments, addenda and designated changes, form a part of this specification to the extent referenced.

1. Federal Specifications (FS): FF-H-111C-74 Hardware, Builders Shelf and Miscellaneous.
2. National Fire Protection Association (NFPA):
 - a. Standard 70, National Electric Code.
 - b. Standard 80, Fire Doors and Other Opening Protective's.
 - c. Standard 101, Life Safety Code.
 - d. Standard 252, Methods of Fire Tests of Door Assemblies.

3. American National Standards Institute (ANSI):
 - a. A156.6, Architectural Door Trim.
 - b. A156.18, Materials and Finishes.
4. Americans with Disabilities Act (ADA): Accessibility Guideline for Buildings and Facilities.
5. Door and Hardware Institute (DHI):
 - a. Keying Systems and Terminology.
 - b. Abbreviations and Symbols.
 - c. Recommended Locations for Builder's Hardware for Custom Steel Doors and Frames.
6. Underwriters Laboratories, Inc. (UL): UL-BMD, Building Materials Directory.

1.4 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
2. Credit MR 5.1 and 5.2: List of proposed regionally manufactured materials and regionally extracted, harvested, or recovered materials.
 - a. Identify each regionally manufactured material, its source, and cost.
 - b. Identify each regionally extracted, harvested or recovered material, its source, and cost.
 - c. Include map or other similar documentation, confirming the following:
 - 1) Driving distance between location of manufacture and Project site.
 - 2) Driving distances between location of extraction, harvesting, or recovery, and Project site.

B. Supplier's Hardware Schedule: Submit a door hardware schedule in accordance with Division 01 in the manner and format prescribed and used herein, complying with the actual construction progress. Hardware schedules are intended for coordination of the work. Review and acceptance by the Architect or Owner does not relieve the Contractor of his exclusive responsibility to fulfill the requirements as shown and specified.

1. Hardware Schedule Content: Based on hardware indicated, organize hardware schedule into Sets or sets showing complete designations of every item required for each door opening. Schedule shall be vertical layout similar to the format used herein. Lines shall be double spaced with pages numbered and dated.
 - a. For doors of different sizes or where hinges, locks or closers are different, a separate heading shall be used. No labeled openings shall be combined with non-labeled openings. Horizontal hardware schedules are not acceptable. Include the following:

- 1) Number, location, hand, fire rating, size and material of each door opening (hands and swings to be determined in relation to key side of opening).
 - 2) Type, style, function, size, finish and quantity of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastening requirements.
 - 5) Explanation of abbreviations used (use nomenclature consistent with DHI's "Abbreviations and Symbols" wherever possible).
 - 6) Special mounting locations and instructions.
2. Combined submittals are not acceptable. Do not combine hardware schedules with door and frame shop drawings.
 3. Schedules not adhering to these parameters will not be reviewed.
- C. Hardware Schedule Index: Furnish an index cross referencing Contract Document door number and hardware Set, and supplier's hardware set.
- D. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- E. Samples for Verification: If requested by the Architect, submit one sample of each type of hardware tagged with full description for coordination with the schedule. These items shall remain on file in the Architect's office until all other similar items have been installed in the project. At that time, items on file will become Owner Maintenance Stock.
- F. Product Certificates:
1. For electrified door hardware, signed by product manufacturer.
 2. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.
- G. Qualification Data: Submit supplier and installer qualifications verifying years of experience; include list of completed projects having similar scope of work identified by name, location, date, reference names and phone numbers.
- H. Operating Instructions: Furnish the Owner with one complete set of installation instructions, including special adjusting tools and maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Furnish information in Compact Disk form, one for each applicable manufacturer, as well as internet web links for each manufacturer.
1. One complete catalog shall be furnished for each manufacturer listed in the approved hardware schedule.
- I. Templates: Provide necessary templates and/or physical hardware to all trades or factories requiring them so they may cut, reinforce or otherwise prepare their material or product to receive the hardware item. If any manufacturer requires physical hardware, ship to them such hardware via prepaid freight in sufficient time to prevent any delay in the execution of their work.
1. Include templates for Contractor furnished and Owner furnished and installed security devices that require door and frame preparation for mortised applications.
 2. It is the responsibility of this Contractor to ensure that doors and frames are factory prepared for all door and frame mounted security devices.

- J. Warranty: Special warranties specified in this Section.
- K. Other Action Submittals: After Hardware Schedule has received Architect's approval; submit the following:
 - 1. Wiring Diagrams: Details of electrified door hardware. Include fire alarm and/or access control system interface where applicable.
 - a. Diagrams shall be complete by opening and shall indicate connections between all components affected. Manufacturers' standard line diagrams are not acceptable. Include the following:
 - 1) System schematic.
 - 2) Point-to-point wiring diagram.
 - 3) Riser diagram.
 - 4) Elevation of each door.
 - b. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

1.5 QUALITY ASSURANCE

- A. Contractor: Assign the installation of hardware to tradesmen experienced in the installation of commercial door hardware.
- B. Installer Qualifications: An employer of workers trained and approved by the Lock, Door Closer, and Exit Device Manufacturers.
 - 1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 2. Installer shall have warehousing facilities in Project's vicinity.
 - 3. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 4. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
- C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- D. Accessibility for Disabled Persons: Special hardware requirements for knurling, slow acting closers or other barrier free opening requirements shall be provided as indicated in the Door Hardware Sets and as required to comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)".
- E. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - 1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be

established at 40 inches or less above the sill.

- F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- G. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Meetings." Review methods and procedures related to electrified door hardware including, but not limited to, the following:
 - 1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
 - 2. Review sequence of operation for each type of electrified door hardware.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- H. Reference Standards: Except as otherwise required by governing authorities or Contract Documents, comply with applicable provisions of Door and Hardware Institute.

1.6 PRODUCT DELIVERY

- A. Deliver door hardware to the Contractor. Direct factory shipments (drop shipments) to the job site are not acceptable.
 - 1. Deliver items of hardware at the proper times to the proper locations (shop or project site) in their original individual containers, complete with necessary appurtenances including screws, keys, manufacturers' printed instructions, and where necessary, installation templates for manufacturer's suggested installation. Mark each individual container with the manufacturer's name and catalog number as they appear in the hardware schedule.
- B. Keys and Cores:
 - 1. Supply construction master keys and cores to Contractor when cylinders are delivered, for use during construction.
 - 2. Hand-deliver permanent cores and keys, including grand master keys, master keys, change keys, control keys, and blank keys directly to the Owner. Under no circumstance shall any permanent keys or cores be furnished direct to the Contractor.
 - a. Keys shall be tagged and delivered to the Development Manager or designated representative. Submit documentation of keying compliance including copies of signed transmittals for all building keys provided by the hardware supplier as part of "Close-Out Procedures" specified in Division 01.
- C. Key Cabinet: Deliver key cabinet to the Owner prior to building occupancy.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Period: Two years from date of Substantial Completion, except as follows:
- a. Manual Closers and Continuous Hinges: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in Part 3 "Hardware Set Schedule" Article.
1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products or products equivalent in function and comparable in quality to named products where other manufacturers are permitted.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Hardware Set Schedule" Article. Products are identified by using door hardware designations, as follows:
1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements.
 2. Manufacturers name or logo shall not be visible on any finished surface exposed to "public" view.

2.2 HARDWARE ITEMS

- A. Hinges: Bommer Industries, Hager Companies, McKinney or Stanley Works.
1. Furnish two hinges for doors 60-inches or less in height and one additional hinge for each additional 30-inches of height or fraction thereof. Unless otherwise specified, hinges for doors through 36-inches wide shall be 4.5" x 4.5"; hinges for doors over 36-inches wide shall be heavy-weight 5" x 4.5". Hinges for labeled doors shall comply with the requirements of NFPA 80.
 2. Furnish non-removable pins (NRP) for all reverse bevel doors receiving keyed locks, rigid outside trim or exit only hardware. Provide hinges with holes in the bottom plug to facilitate pin removal.
 3. Hinges with anti-friction bearings may be furnished in lieu of ball bearing hinges; except where prohibited on fire doors by the requirements of NFPA 80.
- B. Continuous Hinges: Hager Companies (Roton) or Select Products, Inc.
1. Geared-Type: Extruded aluminum with nylon bearings.
- C. Cylinders: Corbin Russwin Architectural Hardware.

1. Cylinders shall be Corbin Russwin 6-Pin, interchangeable core type with cores removable by special control key.
 2. Equip all cylinders with color-coded, temporary cores for use during construction.
 3. Provide cylinders complete with collars, tailpieces and cams as required.
- D. Locks and Latches: Best Access Systems, Corbin Russwin Architectural Hardware, Sargent, Schlage or Yale.
1. Levers shall be cast or solid metal. All internal working parts shall be brass, bronze, steel or stainless steel.
 - a. For each lock and latchset, provide strike box and square corner ASA strike with curved lips of sufficient length to protect frames.
 - b. Furnish knurling to lever on corridor side of door to all doors leading to hazardous areas (e.g. Mechanical Rooms, Electrical Rooms, Elevator Machine Rooms, etc.).
 2. Locks and latches shall be equal to Corbin Russwin ML2000 Series with NSA trim.
 3. Electrical Modifications:
 - a. Locksets specified to be electrified shall be factory modified to electrically lock or electrically unlock, as indicated, upon receipt of a 24V signal and will remain in this mode until signal is interrupted.
 - b. Locks indicated to have "Request-To-Exit" switches shall incorporate internal SPDT contacts for remote signaling of operation of the inside lever handle. Switches shall be used in conjunction with the Electronic Security Control System to accommodate "authorized egress".
 - c. Field-connect electrified locksets to associated power transfer units. Coordinate electrical connection and installation with Divisions 26 and 28.
- E. Exit Devices and Exit Device Accessories: Von Duprin.
1. Refer to the Hardware Set Schedule for function. Where lever handle functions are required on exit devices, they shall match the design and construction of lever handles specified for other locks and latches.
 - a. At mortise exit devices, provide strike box and square corner, stainless steel ASA strike with curved lips of sufficient length to protect frames.
 2. Furnish with provision for concealed mounting, through bolts will not be acceptable.
 3. Furnish keyed devices less cylinders; provide cylinders keyed to building system.
 4. Provide UL-labeled fire-exit hardware at fire-rated openings.
 5. Electrical Modifications:
 - a. Exit devices specified to be electrified shall be factory modified to electrically lock or electrically unlock, as indicated, upon receipt of a 24V signal and will remain in this mode until signal is interrupted.
 - b. Exit devices indicated to have electric latch retraction shall be modified to electrically unlatch (dog down) upon receipt of a 24V signal and will remain unlatched until signal is interrupted.
 - c. Exit devices indicated to have "Request-To-Exit" switches shall incorporate internal SPDT contacts for remote signaling of operation of the push pad. Switches shall be used in conjunction with the Electronic Security Control System to accommodate "authorized egress".

- d. Field-connect electrified exit devices to associated power transfer units. Coordinate electrical connection and installation with Divisions 26 and 28.

F. Surface Closers: LCN Closers.

1. Surface closers shall be LCN 4041 Series.
2. Closer arms shall be forged and fluid shall accommodate all applicable weather conditions. At parallel arm installations, provide manufacturer's heaviest-duty arm assembly.
3. Where factory sized closers are specified, sizes are to be determined by manufacturer's recommendations for door size, location and applicable handicap requirements.
4. Locate surface closers on the least conspicuous side of the door (side opposite public view).

G. Power-Assist Operators: LCN Closers.

1. Operators shall be of heavy-duty construction. Sizes are to be determined by manufacturer's recommendations for door size and location.
2. Operation:
 - a. Pressing actuator switch automatically opens door leaf to 90-degrees, operator then manually closes door after variable time delay expires.
 - b. Provide recessed, wall-mounted stainless steel actuator plates as indicated. Actuators shall operate on voltage supplied by the operator.
 - 1) Engrave Universal Accessibility Symbol on plate; fill with blue enamel paint.
3. Control Unit:
 - a. Micro-processor controlled.
 - b. Provide adjustable opening speed, adjustable backcheck speed, adjustable closing speed, and adjustable hold-open period.
 - c. Provide built-in 3-position switch for "OFF", "ON" and "HOLD-OPEN" operation and to deactivate exterior actuator switch.
 - d. Provide safety-stop feature: If object or obstruction is encountered during opening and/or closing cycles, door operator stops and slowly returns to closed or open position respectively.
 - e. Provide with safety circuit so that if actuator switch is activated when door is latched or locked, power operator resets without operator and/or door damage.
4. Manufacturer shall provide detailed wiring diagrams showing point-to-point hook-up of all components affected (e.g. actuators, operators, power, etc.).
5. Accessories: Furnish complete with fastenings, fittings, and other accessories as required for a complete installation.
6. Coordinate installation and electrical connection with Division 26.

H. Architectural Door Trim: Builders Brass Works, Hager Companies, Rockwood or Trimco.

1. Kick and armor plates shall be beveled on all sides, equal to Hager 194S.
 - a. Except where otherwise indicated or where narrow bottom rails dictate a smaller size, kick plates shall be 10-inches high and armor plates 34-inches high. Width shall be 1.5-inches less than the door width on single doors and 1-inch less than

the door width on double doors.

2. Furnish all flat goods with Phillips undercut, countersunk screws per ANSI A156.6. Trusshead screws are not acceptable.
3. Push and Pull Plates:
 - a. Plates shall be beveled on all sides, fabricated from 1/8-inch thick stainless steel.
 - 1) Push plates shall be 6-inches wide and 16-inches high.
 - 2) Pull plates shall be 4-inches wide and 16-inches high.
 - b. Pulls: Provide a minimum 2-1/4-inches clearance. Pulls shall be 10-inches center-to-center, mounted back-to-back with concealed fasteners.
 - 1) Fabricate pulls from 1-inch round solid bar stock.
4. Push and Pull Bars:
 - a. Fabricate push and pull bars from 1-inch diameter solid stainless steel bar stock. Provide units complete with spacers threaded to accept concealed through bolt attachment including provision for spanner tightening of bolts and assembly. Do not furnish grommets at stile/pull interface.
 - b. Refer to the Hardware Set Schedule for style and design.
- I. Auxiliary Hardware: Hager Companies, Ives, Rockwood or Trimco.
 1. Stops: Furnish wall stops equal to Rockwood 403 wherever door strikes wall. Where wall stops are not suitable, furnish floor stops equal to Rockwood 441CU (with removable riser).
 2. Manual Flush Bolts: Top manual flush bolts shall not exceed 74-inches from floor to centerline.
 3. Silencers: Provide rubber silencers equal to Rockwood 608 for hollow metal frames. Furnish three per single door and four per pair. Silencers are not required at aluminum frames or at doors specified to receive continuous seals or weather-stripping.
- J. Automatic Flush Bolts and Coordinators: Door Controls International, Hager Companies, Ives or Rockwood.
 1. Coordinators shall be continuous across door header, complete with filler plates and closer brackets as required. Furnish coordinators primed for field painting.
 - a. Provide standard strikes with wrought boxes for top bolts.
- K. Overhead Holders and Stops: Architectural Builders Hardware, Glynn-Johnson or Rixson.
 1. Where wall or floor stops will not work, furnish concealed overhead stops equal to Glynn-Johnson 410S.
- L. Thresholds, Weather-stripping and Seals: Hager Companies, National Guard Products, Pemko, Reese Enterprises or Zero International.
 1. Refer to the Hardware Set Schedule for grade and style.
 2. Smoke Seals: At all fire-rated wood doors and at all other doors required to be 'smoke

resistant', provide the following:

- a. Head and Jambs: Smoke seals equal to Pemko S88BL.
 - b. Meeting Stile at Pairs: Overlapping astragal seals equal to one Pemko 375CR or two Pemko 316AS as appropriate for intended hardware operation.
 - c. Refer to the Drawings for locations.
3. Where required, field-modify thresholds to receive strikes for exit devices and flush bolts.
- M. Key Control System: Lund Equipment, MMF Key Control Products or Telkee.
1. Wall-mounted metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150% of the number of cylinders required herein.
 - a. Equip cabinet with hinged-panel door, key-holding panels, and pin-tumbler cylinder door lock.
 - b. Cross-Index System: Multiple-index system for recording key information. Include three receipt forms for each key-holding hook.
- N. Power Transfer Pivots: Architectural Builders Hardware, Securitron or Von Duprin.
1. Concealed PTFE-jacketed wires, secured at each leaf and continuous through sleeve.
- O. Magnetic Door Contacts: Magnetic door contacts are furnished by the Security Sub-contractor. Furnish templates for products indicated so doors and frames are properly factory-machined to receive material without field-modification.
- P. Special Tools: Provide any necessary special tools (e.g. spanner and socket wrenches, dogging keys, etc.) required to service and adjust hardware items.

2.3 FINISHES

- A. Base metals: Produce hardware units of basic metal and forming method indicated, using manufacturers standard metal alloy composition, temper and hardness, but in no case of lesser quality than specified or inferred by use of a particular manufacturer's number, style or grade or as established by appropriate referenced specification listed herein.
- B. Finishes: Finishes shall conform to the quality of finish including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standards, but in no case less than the standards established by ANSI/BHMA A156.18 or Federal Specifications FF-H-111C as applicable.
1. All exposed hardware except shall be satin chrome plated, ANSI/BHMA 626/US26D.
 - a. Surface closers shall be powder coated to match satin chrome.
 - b. Butt hinges on exterior doors shall be satin stainless steel, ANSI/BHMA 630/US32D.
 - c. Push-pulls and flat goods shall be satin stainless steel, ANSI/BHMA 630/US32D.
 - d. Continuous geared hinges shall be powder coated to match storefront, coordinate with Division 08 Section "Aluminum Framed Entrances and Storefronts" for color.

2. Where painting of primed surfaces is required, refer to Division 09 specifications.

2.4 KEYS AND KEYING

- A. Keying: Provide the type of system required (e.g. master, grand master, great grand master). Nomenclature and layout shall be consistent with DHI "Keying Systems and Terminology".
 1. All cylinder cores shall operate on the existing Montgomery College/Rockville Campus Corbin Russwin N6 Keyway.
 2. All permanent cores shall be "0-bitted"; final keying shall be performed by the College Locksmith.
- B. Keys: Provide keys of nickel silver only in the following quantities:
 1. Three change keys per cylinder.
 2. Five master keys (per set).
 3. Three grand master keys (as required).
 4. Thirty key blanks.
 5. Ten permanent and ten temporary control keys (for removal of cores).
 6. Fifteen construction master keys (for use during construction).
- C. Identification:
 1. Stamp change keys with the key change number.
 2. Stamp change keys with the key change number; stamp all master keys and grand master keys "DO NOT DUPLICATE".
 3. Stamp the applicable key control symbol in a concealed place on each core.

2.5 FASTENERS

- A. Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping or sheet metal screws except as specifically indicated.
 1. Furnish screws for installation with each hardware item. Provide Phillips flat head or oval head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces of other work, to match the finish of such work as closely as possible, except as otherwise indicated.
 - a. Where wood screws are required they shall be full thread (to the head) type. Combination wood/machine screws, in lieu of wood screws, are not acceptable.
 2. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard manufactured units of the type specified are available with concealed fasteners. Do not use through bolts for installation except where it is not possible to adequately reinforce the work, to accept machine screws or concealed fasteners or another standard type, to satisfactory avoid the use of through bolts. Grommet nuts and cealnuts are not acceptable.
 3. Furnish fasteners which are compatible with both the unit fastened and the substrate, and which will not cause corrosion or deterioration of hardware, base material reinforcement or fastener. Furnish wall stops with "Toggler" anchors and wood screws. Furnish

thresholds and floor stops with lead anchors and 1/4-20 stainless steel machine screws.

PART 3 - EXECUTION

3.1 STORAGE AND HANDLING

- A. Representatives of the Contractor and the Hardware Supplier shall jointly inventory the door hardware. Replace items damaged in shipment promptly and with proper material without additional cost to the Contractor. Handle all hardware in a manner to eliminate marring, scratching or damage.
 - 1. A dry, locked storage space complete with adequate shelving shall be set aside for the purpose of unpacking, sorting out, checking and storage. Control the handling and installation of hardware items, whether immediately replaceable or not, so completion of the work will not be delayed by losses before or after installation.
 - 2. Tag each item or package separately, with identification related to the final approved hardware schedule, and include basic installation instructions in the package. Furnish hardware items of proper design for use on doors and frames of thickness, profile, swing, security and similar requirements indicated as necessary for proper installation and function.

3.2 COORDINATION

- A. Coordinate Door Hardware Schedule submission and hardware ordering to insure delivery of all items as directed by the Contractor.
 - 1. Prior to ordering any hardware, examine the shop drawings and details of doors and frames and other substrate suppliers to determine that the proper type and size pieces of hardware are being furnished. No extra for material or labor will be allowed for any corrections that should have been eliminated by proper prior coordination.
- B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, and access control system.
- D. Coordination with Adjacent Finishes:
 - 1. If cutting and fitting are required to install hardware onto or into surfaces that are later painted or finished in another way, install each item completely and then remove and store in secure place during finish application.
 - 2. After completion of finishes, reinstall each item.
 - 3. Do not install surface mounted items until finishes are complete on substrate.

3.3 INSTALLATION

- A. Install each hardware item in accordance with final approved Hardware Schedule and manufacturer's instructions.
1. Set hardware level, plumb and true to line and location.
 2. Adjust and reinforce attachment substrate as required for proper installation and operation of hardware.
 3. Drill and countersink units which are not factory-prepared for anchorage fasteners; space fasteners and anchors uniformly, in accordance with industry standards.
- B. Hardware Mounting Heights:
1. Provide heights as indicated on Drawings, except as otherwise required for compliance with governing regulations.
 2. Where heights are not indicated, comply with mounting requirements of DHI "Recommended Locations for Builder's Hardware" on custom steel doors and frames.
- C. Hinges:
1. Install steel doors and wood doors to comply with reference standards, as specified in door sections.
 2. Where shimming is required to comply with tolerances, provide metal shims only.
- D. Closers:
1. Do not install parallel arm closers until after weather-stripping or seals have been installed on head frame (where weather-stripping or seals are scheduled).
 2. Do not cut weather-stripping or seals for attachment of closer brackets or shoes.
 3. Adjust closers to control door swing and to provide positive latching of doors.
 - a. Adjust closers not to exceed following manual opening forces:
 - 1) Exterior doors: As required to close and latch each leaf.
 - 2) Interior doors (non-fire-rated): Maximum 5-pound opening force.
 - 3) Fire-rated doors: As required to close and latch each leaf.
 - b. After air-handling system has been balanced, make final adjustment of all closers.
- E. Door Stops:
1. Install stops for maximum degree of door opening swing allowed by conditions of installation.
 2. Locate floor stops so as not to create a tripping hazard.
 3. Locate wall stops centered on spindle of lever handles.
- F. Weather-stripping and Seals:
1. Install continuous around door heads and jambs, and meeting stiles of pairs of doors.
 2. Install bottom weather-stripping and automatic door bottoms for full width of door.
 3. Do not cut weather-stripping or seals for attachment of closer brackets or shoes.
 4. Align rain drips with the bottom edge of the door frame rabbet, set in a bed of sealant, and attach with stainless steel fasteners.

- G. Cylinder Cores: The Owner or Owner's agent will install permanent cores and return the construction cores to the Contractor.
 - 1. It is the Contractor's responsibility to return the construction cores and keys to the manufacturer. Construction cores and keys remain the property of the Corbin Russwin.
- H. Key Cabinet: Deliver key cabinet to the Owner prior to building occupancy and install where directed. Instruct the Owner in the use of the key control system.
- I. Fire Doors and Exit Doors: Hardware for labeled fire doors shall be installed in accordance with the requirements of NFPA 80. Hardware for listed exit doors shall be installed in accordance with the requirements of NFPA 101.

3.4 ADJUST AND CLEAN

- A. General: To insure proper operation and function of every unit, adjust and check each operating item of hardware and each door. Lubricate moving parts with type lubrication recommended by the manufacturer (graphite-type if no other recommended). Replace unit that cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made.
 - 1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Verify that the Owner has been supplied with manufacturers' installation and maintenance manuals, catalogs, and any special adjusting tools normally supplied by the manufacturer.
- B. Final Adjustment: When hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and perform a final check and adjustment of all hardware items in such space or area. Clean and re-lubricate as necessary to restore proper function and finish of hardware and doors.
 - 1. Prior to acceptance of any electrical hardware system, an operational test shall be performed to determine if devices are functioning as intended by the specifications. Wiring shall be tested for correct voltage, current-carrying capacity, and proper grounding. Stray voltages in lock wiring shall be eliminated to prevent locking devices from releasing in critical situations.
- C. Six-Month Adjustment: Approximately six months after date of Substantial Completion, Installer shall perform the following:
 - 1. Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.
 - 2. Consult with and instruct Owner's personnel on recommended maintenance procedures.
 - 3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

3.5 HARDWARE SET SCHEDULE

Set 310

	Hinges BB1168	Hager
1	Exit device 98L-F x 996L-BE	Von Duprin
1	Surface closer 4041 (P4041-EDA at Door No. S3A)	LCN
1	Kick plate 194S	Hager
1	Stop	Rockwood
Set 311		
	Hinges BB1168	Hager
1	Exit devices 98L-F x 996L-BE	Von Duprin
1	Removable Mullion KR9954 x 154	Von Duprin
2	Surface Closers 4041	Corbin Russwin
2	Kick Plates	Hager
2		Stops
Set 412		
1	Continuous hinge 780-112HD (finish to match storefront)	Hager
1	Push pad 350	Von Duprin
1	Pull 976P (30-inches) x TB fasteners	Hager
1	Power-assist operator 4640 x SNB fasteners	LCN
1	Jamb actuator 8310-818T (corridor)	LCN
1	Wall actuator 8310-3856TWF (vestibule)	LCN
1	RF receiver 7910-931	LCN
1	Floor stop 441CU	Rockwood
	Weather-stripping by door manufacturer	
Set 430		
1	Continuous hinge 780-112HD (finish to match storefront)	Hager
1	Exit device LD-35A-EO x concealed fastening	Von Duprin
1	Surface closer P4041-CUSH x 4040-18PA x SNB fasteners	LCN
1	Threshold 2005AT	Pemko
1	Magnetic contact (prep only for Sentrol #1078)	
	Weather-stripping by door manufacturer	
Set 432		
1	Continuous hinge 780-112HD x CPT (finish to match storefront)	Hager
1	Electrified exit device RX-EL-35A-NL-OP x concealed fastening	Von Duprin
1	Cylinder – as required	Corbin Russwin
1	Pull 976P (30-inches) x TB fasteners	Hager
1	Power-assist operator 4640 x SNB fasteners	LCN
1	Jamb actuator 8310-818T (interior)	LCN
1	Wall actuator 8310-3856TWF (exterior)	LCN
1	RF receiver 7910-931	LCN
1	Threshold 2005AT	Pemko
1	Power supply PS873-2	Von Duprin
1	Power transfer pivot EPT-10	Von Duprin
1	Magnetic contact (prep only for Sentrol #1078)	
1	Floor stop 466	Rockwood
	Weather-stripping by door manufacturer	
Set 435		
2	Continuous hinge 780-112HD x CPT (finish to match storefront)	Hager
2	Electrified exit device RX-EL-35A-EO x concealed fastening	Von Duprin
2	Pull 976P (30-inches) x TB fasteners	Hager

2	Surface closer P4041-CUSH x 4040-18PA x SNB fasteners	LCN
1	Threshold 2005AT	Pemko
2	Power transfer pivot EPT-10	Von Duprin
2	Magnetic contact (prep only for Sentrol #1078) Weather-stripping by door manufacturer	

Set 440

2	Continuous hinges 780-112HD x CPT (finish to match storefront)	Hager
2	Electrified exit devices RX-EL-35A-EO x concealed fastening	Von Duprin
1	Removable mullion KR4954 x 154	Von Duprin
1	Cylinder – as required	Corbin Russwin
2	Pulls 976P (30-inches) x TB fasteners	Hager
2	Surface closers P4041-CUSH x 4040-18PA x SNB fasteners	LCN
1	Threshold 2005AT	Pemko
1	Power supply PS873-2	Von Duprin
2	Power transfer pivots EPT-10	Von Duprin
2	Magnetic contacts (prep only for Sentrol #1078) Weather-stripping by door manufacturer	

Set 515

	Hinges BB1279	Hager
1	Electrified lockset ML20905 x M17 – FSE	Corbin Russwin
1	Coat hook 3071	Trimco
1	Power transfer pivot EPT-2	Von Duprin
1	Stop	Rockwood

Set 710

	Hinges BB1279	Hager
1	Lockset ML2055 x M17	Corbin Russwin
1	Stop	Rockwood

Set 810

	Hinges BB1279	Hager
1	Lockset ML2057 x M17	Corbin Russwin
1	Stop	Rockwood

Set 812

	Hinges BB1279	Hager
1	Electrified lockset ML20905 x M17 x M92 – FSE	Corbin Russwin
1	Surface closer 4041-DEL / P4041-DEL-EDA	LCN
1	Kick plate 194S	Hager
1	Power transfer pivot EPT-10	Von Duprin
1	Magnetic contact (prep only for Sentrol #1078)	
1	Stop	Rockwood

Set 813

	Hinges BB1279 (BB1168 at doors over 36-inches wide)	Hager
1	Electrified lockset ML20905 x M17 x M92 – FSE	Corbin Russwin
1	Surface closer 4041-H / P4041-H-EDA	LCN
1	Kick plate 194S	Hager
1	Power transfer pivot EPT-10	Von Duprin
1	Magnetic contact (prep only for Sentrol #1078)	
1	Stop	Rockwood

Set 814

	Hinges BB1279	Hager
1	Electrified lockset ML20905 x M17 x M92 – FSE	Corbin Russwin
1	Surface closer 4041 / P4041-EDA	LCN
1	Kick plate 194S	Hager
1	Power transfer pivot EPT-10	Von Duprin
1	Magnetic contact (prep only for Sentrol #1078)	
1	Stop	Rockwood

Set 815

	Hinges BB1279 (BB1168 at doors over 36-inches wide)	Hager
1	Electrified lockset ML20905 x M17 x M92 – FSE	Corbin Russwin
1	Surface closer 4041 / P4041-EDA	LCN
1	Power transfer pivot EPT-10	Von Duprin
1	Magnetic contact (prep only for Sentrol #1078)	
1	Stop	Rockwood

Set 824

	Hinges BB1279	Hager
1	Electrified lockset ML20905 x M17 x M92 – FSE	Corbin Russwin
1 set	Automatic flush bolts 1842 / 1942	Rockwood
1	Coordinator 1600 x USP	Rockwood
1	Dust strike 570	Rockwood
2	Surface closers 4041	LCN
2	Kick plates 194S	Hager
1	Power transfer pivot EPT-10	Von Duprin
2	Magnetic contacts (prep only for Sentrol #1078)	
2	Stops	Rockwood
	Astragal by door manufacturer	

Set 825

	Hinges BB1279	Hager
1	Electrified lockset ML20905 x M17 x M92 – FSE	Corbin Russwin
2	Flush bolts 555	Rockwood
1	Dust strike 570	Rockwood
1	Surface closer 4041 / P4041-EDA	LCN
1	Power transfer pivot EPT-10	Von Duprin
2	Magnetic contacts (prep only for Sentrol #1078)	
2	Stops	Rockwood
	Astragal by door manufacturer	

Set 826

	Hinges BB1279	Hager
1	Electrified lockset ML20905 x M17 x M92 – FSE	Corbin Russwin
1 set	Automatic flush bolts 1842 / 1942	Rockwood
1	Dust strike 570	Rockwood
2	Surface closer TJ4041 x 4040-18G	LCN
1	Coordinator 1600 x USP	Rockwood
1 set	Seals 350CSPK – Head & Jamb	Pemko
1	Threshold 151A	Pemko
1	Meeting stile gasket 375CR	Pemko
2	Automatic door bottom 4301CPKL	Pemko
1	Power transfer pivot EPT-10	Von Duprin
2	Magnetic contacts (prep only for Sentrol #1078)	

2 Stops
Astragal by door manufacturer

Rockwood

END OF SECTION 087100

SECTION 088000 – INTERIOR GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Doors.
 - 3. Interior borrowed lites.
 - 4. Fire rated glazing
- B. Related Sections:
 - 1. Division 08 Section "Exterior Glazing."

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation

techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.

3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. LEED Submittals:
 1. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.
- C. Glass Samples: For each type of the following products; 12 inches square.
 1. Coated glass.
 2. Laminated glass.
 3. Fire-resistive glazing products.
- D. Glazing Accessory Samples: For gaskets sealants and colored spacers, in 12inch lengths.
- E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- G. Qualification Data: For installers manufacturers of insulating-glass units with sputter-coated, low-e coatings glass testing agency and sealant testing agency.
- H. Product Certificates: For glass and glazing products, from manufacturer.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tinted glass coated glass insulating glass glazing sealants and glazing gaskets.
 1. For glazing sealants, provide test reports based on test formulations within previous 36-month period.
- J. Preconstruction adhesion and compatibility test report.
- K. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- D. Source Limitations for Glass: Obtain glass types indicated from single source from single manufacturer for each glass type.
- E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.
- J. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 - 2. For laminated-glass lites, properties are based on products of construction indicated.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 - 1. For uncoated glass, comply with requirements for Condition A.
 - 2. For coated vision glass, comply with requirements for Condition C (other coated glass).
 - 3. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat strengthened) float glass where safety glass is indicated."

2.3 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Color: Clear unless otherwise indicated.
- B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

2.4 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies NFPA 257 for window assemblies.
- B. Monolithic Ceramic Glazing: Clear, ceramic flat glass; 3/16-inch nominal thickness.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); Standard FireLite.
 - b. Safti First; SuperLite C/P.
 - c. Schott North America, Inc.;
 - d. Vetrotech Saint-Gobain; SGG Keralite FR-R.

2.5 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from the following:
 - 1. Neoprene complying with ASTM C 864.
 - 2. EPDM complying with ASTM C 864.
 - 3. Silicone complying with ASTM C 1115.
 - 4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

2.6 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. VOC Content: For sealants used inside of the weatherproofing system, not more than

250 g/L when calculated according to 40 CFR 59, Subpart D.

4. Colors of Exposed Glazing Sealants: Match Architect's samples.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. Tremco Incorporated; Spectrem 1.
- C. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets

and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 088001 - EXTERIOR GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Glazed curtain walls.
 - 2. Glazed Storefront Framing and Entrances.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2003 International Building Code by a qualified professional engineer, using the following design criteria:
 - 1. Design Wind Pressures: As indicated on Drawings.
 - 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on Drawings.
 - 3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (), whichever is less.
 5. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
1. Temperature Change: 120 deg F (), ambient; 180 deg F (), material surfaces.

1.5 ACTION SUBMITTALS

- A. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- B. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass and glazing products, from manufacturer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulating glass.
 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- C. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- E. Source Limitations for Glass: Obtain insulating glass from single source from single manufacturer for each glass type.
- F. Source Limitations for Glazing Accessories: Obtain from single source from single

manufacturer for each product and installation method.

- G. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

- B. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 2. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F ().
 3. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 4. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Treated Ultraclear Float Glass: ASTM C 1048, Type I, Quality-Q3, Class I (clear) complying with visible light transmission not less than 54 percent and solar heat gain coefficient not less than 0.28 and other requirements specified.
1. For uncoated glass, comply with requirements for Condition A.
 2. For coated vision glass, comply with requirements for Condition C (other coated glass.)
 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Guardian Industries Corp.; Ultrawhite.
 - b. Pilkington North America; Optiwhite.
 - c. PPG Industries, Inc.; Starphire.
- C. Silicone-Coated Spandrel Glass: ASTM C 1048, Condition C, Type I and complying with other requirements specified.
1. Silicone Coating Color: ICD High Performance Coatings: Opaci-Coat 2-743 Solex, to match spandrel glass color at adjacent Science East and Science Center buildings.

2.3 INSULATING GLASS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Industries Corp, SuperNeutral 54, or a comparable product by one of the following:
1. PPG Industries, Inc.
 2. Pilkington North America
- B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
 2. Spacer: Aluminum with mill or clear anodic finish.
 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

2.4 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.5 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

2.6 INSULATING-GLASS TYPES

- A. Glass Type G1: Low-e-coated, clear insulating glass.
1. Overall Unit Thickness: 1 inch ().

2. Thickness of Each Glass Lite: 6.0 mm.
 3. Outdoor Lite: Fully tempered float glass.
 4. Interspace Content: Argon.
 5. Indoor Lite: Fully tempered float glass.
 6. Low-E Coating: Pyrolytic on second surface.
 7. Visible Light Transmittance: 54 percent minimum.
 8. Winter Nighttime U-Factor: 0.29 maximum.
 9. Summer Daytime U-Factor: 0.27 maximum.
 10. Solar Heat Gain Coefficient: 0.28 maximum.
- B. Glass Type G2: Silicone-coated, low-e, insulating spandrel glass.
1. Overall Unit Thickness: 1 inch ().
 2. Thickness of Each Glass Lite: 6.0 mm.
 3. Outdoor Lite: Fully tempered float glass.
 4. Interspace Content: Argon.
 5. Indoor Lite: Fully tempered float glass.
 6. Low-E Coating: Pyrolytic on second surface.
 7. Opaque Coating Location: Fourth surface.
 8. Winter Nighttime U-Factor: 0.29 maximum.
 9. Summer Daytime U-Factor: 0.27 maximum.
- C. Glass Type G3: Low-e-coated, [triple glazed] clear insulating glass.
1. Overall Unit Thickness: 2 inches ().
 2. Thickness of Each Glass Lite: 6.0 mm.
 3. Outdoor Lite: Fully tempered float glass.
 4. Interspace Content: Argon.
 5. Center Lite: Fully tempered float glass.
 6. Indoor Lite: Fully tempered float glass.
 7. Low-E Coating: Pyrolytic on second surface.
 8. Visible Light Transmittance: 54 percent minimum.
 9. Winter Nighttime U-Factor: 0.29 maximum.
 10. Summer Daytime U-Factor: 0.27 maximum.
 11. Solar Heat Gain Coefficient: 0.28 maximum.
- D. Glass Type G4: Silicone-coated, low-e, [triple glazed] insulating spandrel glass.
1. Overall Unit Thickness: 2 inches ().
 2. Thickness of Each Glass Lite: 6.0 mm.
 3. Outdoor Lite: Fully tempered float glass.
 4. Interspace Content: Argon.
 5. Center Lite: Fully tempered float glass.
 6. Indoor Lite: Fully tempered float glass.
 7. Low-E Coating: Pyrolytic on second surface.
 8. Opaque Coating Location: Fourth surface.
 9. Winter Nighttime U-Factor: 0.29 maximum.
 10. Summer Daytime U-Factor: 0.27 maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (.).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of

glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch () minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

3.4 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088001

SECTION 088113 - DECORATIVE GLASS GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following decorative glass for interior applications:
 - 1. Acid etched.
 - 2. Laminated.
 - 3. Glass with decorative film overlay.
- B. Related Sections:
 - 1. Section 057300 "Decorative Metal Railings" for glass panels in metal railings.
 - 2. Section 088000 "Glazing" for standard glass products.

1.3 DEFINITION

- A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass installed adjacent to walking surfaces, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1.6 ACTION SUBMITTALS

- A. Product Data: For each decorative-glass and glazing product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For glazing sealants used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For decorative glass. Show fabrication and installation details. Include the following:
 - 1. Size and location of penetrations.
 - 2. Glazing method.
 - 3. Mounting method.
 - 4. Attachments to other work.
 - 5. Full-size details of edge-finished profiles.
- D. Glass Samples: For the following products, 12 inches (300 mm) square:
 - 1. Each type of decorative glass.
 - 2. Each edge treatment on type of decorative glass.
 - 3. Each decorative film overlay on type of decorative glass.
 - 4. Each applied coating on type of decorative glass.
- E. Glazing Accessory Samples: For sealants, in 12-inch (300-mm) lengths.
- F. Product Schedule: For decorative glass.
- G. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each type of decorative glass, from manufacturer.
- C. Warranty: Sample of special warranty.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of decorative glass and each decorative film overlay and each applied coating to include in maintenance manuals.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under NGA's Certified Glass Installer Program.
- B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Source Limitations for Glass: Obtain each type of decorative glass from single source from single manufacturer.
- D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer, for each product and installation method.
- E. Glazing Publications: Comply with published recommendations in GANA's "Glazing Manual" unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
- F. Safety Glazing: Where safety glazing is indicated, comply with testing requirements in 16 CFR 1201 for Category II materials.
- G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- H. Preinstallation Conference: Conduct conference at Project site.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect decorative glass and glazing materials according to manufacturer's written instructions and as needed to prevent damage to surfaces and edges.
- B. Retain packaging and sequencing numbers for decorative-glass units.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install decorative glass until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.12 WARRANTY

- A. Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with requirements indicated. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with requirements indicated. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.2 MONOLITHIC-GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.3 DECORATIVE GLASS TYPES

- A. Decorative Glass: Provide decorative glass types as indicated on the drawings. Subject to conformance with design intent and specifications, products of other manufacturers may be submitted for approval in accordance with General Conditions of the project and Division 01 requirements.
- B. Decorative Film Overlay: Provide decorative glass film overlay as indicated on the drawings. Subject to conformance with design intent and specifications, products of other manufacturers may be submitted for approval in accordance with General Conditions of the project and Division 01 requirements.
1. Use translucent, dimensionally stable, cast PVC film, 2-mil- (0.05-mm-) minimum thickness, with pressure-sensitive, clear adhesive back for adhering to glass and releasable protective backing.

2.4 GLAZING MATERIALS

- A. Glazing Gaskets, Sealants, Tapes, and Miscellaneous Glazing Materials:
 - 1. Elastomeric Glazing Sealants: ASTM C 920.
 - a. Color: As selected by Architect from manufacturer's full range.
- B. Joint Sealants: As specified in Section 079200 "Interior Joint Sealants."

2.5 HARDWARE FOR GLASS INSTALLATION

- A. Hardware: Provide as indicated on drawings and in accordance with decorative glass manufacturer's recommendations.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- C. Gaskets and Wedges: Manufacturer's standard, compatible with decorative glass type indicated.
- D. Anchors and Inserts: Provide devices as required for hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide stainless-steel anchors and inserts for applications on inside face of exterior walls and where indicated.

2.6 DECORATIVE-GLASS FABRICATION

- A. Fabricate decorative glass and provide other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written recommendations of product manufacturer and with referenced glazing standard.
- B. Edge Finishing: Fabricate finished edges to produce smooth, polished edges without chips, scratches, or warps.
- C. Decorative Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, with graphic image as indicated on Drawings to the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine decorative-glass framing members, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Minimum required face or edge clearances.

3. Effective sealing between joints of decorative-glass framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate orientation of outer surfaces. Label or mark units as needed so that surface orientation is readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 INSTALLATION

A. Set decorative-glass units in each series true in line with uniform orientation, pattern, draw, bow, and similar characteristics.

B. Set decorative glass in locations indicated on Drawings. Install glass with hardware and accessories according to hardware manufacturer's written instructions. Attach hardware securely to mounting surfaces and building structure.

3.4 GLAZING, GENERAL

A. Decorative Glass: Install glazing as specified in Section 088000 "Glazing."

B. Comply with combined written instructions of manufacturers of gaskets, glass, sealants, tapes, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

C. Adjust glazing channel dimensions during installation as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

F. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

H. Provide spacers for glass lites where length plus width is more than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances, and to comply with system performance requirements.
 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- I. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.5 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels and between glass-to-glass joints to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants smooth.

3.6 CLEANING AND PROTECTION

- A. Protect decorative glass from damage immediately after installation by attaching crossed streamers to framing and held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088113

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed, extruded aluminum louvers.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.
- C. Samples: For each type of metal finish required.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
- B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Drainable-Blade Louver L1:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide Greenheck Fan Corporation; Drainable Blade ESD-403 or comparable product by one of the following:
 - a. Greenheck Fan Corporation.
 - b. Nystrom, Inc.
 - c. Ruskin Company; Tomkins PLC.
 - 3. Louver Depth: 4 inches.
 - 4. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
 - 5. Mullion Type: Exposed.
 - 6. Louver Performance Ratings:
 - a. Free Area: Not less than 6.4 sq. ft. for 48-inch- wide by 48-inch- high louver (40%.)
 - b. Point of Beginning Water Penetration: Not less than 1050 fpm.
 - c. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area intake velocity and not more than 0.15-inch wg static pressure drop at 800-fpm free area exhaust velocity.
 - 7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening Insect screening.
- B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
 - 2. Finish: Same finish as louver frames to which louver screens are attached.
 - 3. Bird screen type: Non-rewirable, U-shaped frames.
 - 4. Insect screen type: Rewirable frames with a driven spline.
- D. Louver Screening for Aluminum Louvers:
 - 1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inchwire.
 - 2. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inchwire.

2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
 - 2. For color-finished louvers, use fasteners with heads that match color of louvers.
- C. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Interior flange unless otherwise indicated.
 - D. Include supports, anchorages, and accessories required for complete assembly.
 - E. Provide subsills made of same material as louvers for recessed louvers.
- 2.7 ALUMINUM FINISHES
- A. Finish louvers after assembly.
 - B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 092100 – ACOUSTIC TREATMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes Spray-Applied Acoustical Cement Plaster

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated
- B. Manufacturer's installation instructions, test data substantiating compliance with quality assurance.
- C. Submit 12 inch square sample of sprayed-on acoustical material showing texture variations for approval. All samples must be certified by manufacturer that they are representative of the texture which was acoustically tested in supporting acoustical test reports.
- D. Test reports from all suppliers showing material to be 100% free of asbestos, mineral fiber, polystyrene and cellulose.

1.4 QUALITY ASSURANCE

- A. Provide Portland cement-vermiculite material which has been tested to and achieved the following values:

- B.

Test method/ authority	Property	Value
ASTM E605	Density	41 Lbs./Cu.Ft.
ASTM E761	Compressive Strength	300 psi.
ASTM E736-86	Bond Strength	5000 Lbs./Sq Ft.
ASTM E84-87	Surface Burning Characteristics	0 Flame Spread 0 Smoke Developed
ASTM C423-84A	Sound Absorption	0.60 NRC @ 1" Thick 0.50 NRC @ .5" Thick
ASTM E136	Combustibility	Non-Combustible
ASTM D2240	Hardness	70

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Keep material dry until ready for use.

1.6 WARRANTY

- A. Manufacturer shall warrant the material to be supplied, agreeing to repair/replace that which has cracked, flaked, dusted excessively, peeled or fallen from substrate, or otherwise deteriorated to a condition where it would not perform effectively as intended for a sound absorbent purpose; due to defective materials and not due to abuse, improper maintenance, unforeseeable ambient exposures, or other causes beyond anticipated conditions by manufacturer. The warranty period will be 10 years from date of substantial completion.

PART 2 - PRODUCTS

2.1 Spray-Applied Acoustical Cement Plaster (**AF-1**)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the following or a comparable product:
 - 1. Manufacturer: Acoustement 40 manufactured by Pyrok, Inc., Mamaroneck, N.Y. (914) 777-7070, info@pyrokinc.com
 - 2. Color: Selected from the manufacturer's full range.
 - 3. Texture: Standard Texture
 - 4. Thickness: 1 inch.

PART 3 - EXECUTION

3.1 Inspection and preparation

- A. Examine all substrates and conditions. Assure substrate is free of oil, grease, dirt, paint, or other matter which would impair bond or install metal lath as recommended by the manufacturer. Do not proceed until said substrate and conditions are acceptable.
- B. Prepare substrate by filling voids and cracks and offsets, remove projections that result in telegraphing presence of imperfections.
- C. Prime substrate with primer or bonding agent as recommended by the manufacturer.
- D. Do not apply insulation material when temperature is below 40 degrees F (ambient), or substrate is below 40 degrees F.
- E. Mask all adjoining surfaces in order to minimize damage from overspray.
- F. Provide ventilation if required, and avoid excess drying rates.
- G. Provide tarps or temporary enclosures as necessary to confine operations.

- H. Perform all patching and repairing of insulation required to be done due to cutting, etc., by other trades.

3.2 Application

- A. Apply in accordance with manufacturer's instructions (except no spray pass shall exceed 1/4" thickness) using any rotary-stator plastering pump or other spray equipment approved by the manufacturer.
- B. Install to thickness indicated or thickness required to achieve NRC specified.
- C. Ensure that texture and color are all as per control sample.

3.3 Cleaning and patching

- A. Remove overspray and fall out material immediately upon completion of the work in each area. Clean surfaces to remove evidence of soiling. Repair or replace damaged work surfaces to acceptable conditions.
- B. Coordinate work with other work, to minimize possibility of damage to insulation resulting from performance of subsequent work. As other units of work are completed in each area, patch damaged areas or surfaces of insulation by over spraying to match original installations, or by patching procedures as required to provide acceptable results.

END OF SECTION 092100

SECTION 092116 - GYPSUM BOARD SHAFT-WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes gypsum board shaft-wall assemblies for the following:
 - 1. Shaft-wall enclosures.
 - 2. Chase enclosures.
 - 3. Horizontal enclosures.
- B. Related Sections include the following:
 - 1. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board shaft-wall assemblies.

1.3 SUBMITTALS

- A. Product Data: For each gypsum board shaft-wall assembly indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

1.4 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Provide materials and construction identical to those of assemblies with fire-resistance ratings determined according to ASTM E 119 by a testing and inspecting agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures for installing gypsum board shaft-wall assemblies including, but not limited to, the following:
 - 1. Fasteners proposed for anchoring nonstructural steel framing to building structure.
 - 2. Sprayed fire-resistive materials applied to structural steel framing.
 - 3. Wiring devices in shaft-wall assemblies.
 - 4. Doors and other items penetrating shaft-wall assemblies.

5. Items supported by shaft-wall-assembly framing.
6. Mechanical work enclosed within shaft-wall assemblies.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
- C. Stack panels flat on leveled supports off floor or slab to prevent sagging.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. G-P Gypsum.
 2. National Gypsum Company.
 3. USG Corporation.

2.2 GYPSUM BOARD SHAFT-WALL ASSEMBLIES, GENERAL

- A. Provide materials and components complying with requirements of fire-resistance-rated assemblies indicated.
 1. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.
 2. Provide auxiliary materials complying with gypsum board shaft-wall assembly manufacturer's written recommendations.

2.3 PANEL PRODUCTS

- A. Gypsum Liner Panels: Comply with ASTM C 442/C 442M.
 - 1. Type X: Manufacturer's proprietary liner panels with moisture-resistant paper faces.
 - a. Core: 1 inch (25.4 mm) thick.
 - b. Long Edges: Double bevel.
 - 2. Moisture- and Mold-Resistant Type X: Manufacturer's proprietary liner panels with moisture- and mold-resistant core and surfaces; comply with ASTM D 3273.
 - a. Core: 1 inch (25.4 mm) thick.
 - b. Long Edges: Double bevel.
- B. Gypsum Board: As specified in Division 09 Section "Gypsum Board."
- C. Water-Resistant Gypsum Backing Board: As specified in Division 09 Section "Gypsum Board."
- D. Cementitious Backer Units: As specified in Division 09 Section "Tiling."

2.4 NON-LOAD-BEARING STEEL FRAMING

- A. Framing Members: Comply with ASTM C 754 for conditions indicated.
- B. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 - 1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes specified in Division 09 Section "Gypsum Board" that comply with gypsum board shaft-wall assembly manufacturer's written recommendations for application indicated.
- C. Gypsum Board Joint-Treatment Materials: As specified in Division 09 Section "Gypsum Board."
- D. Laminating Adhesive: Adhesive or joint compound recommended by manufacturer for directly adhering gypsum face-layer panels and gypsum-base face-layer panels to backing-layer panels in multilayer construction.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

- F. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 - 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
 - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- G. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing), produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- H. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
 - 1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 GYPSUM BOARD SHAFT-WALL ASSEMBLIES

- A. Basis-of-Design Product: As indicated on Drawings by design designation of a qualified testing agency.
- B. Fire-Resistance Rating: As indicated.
- C. STC Rating: As indicated.
- D. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
 - 1. Depth: As indicated.
 - 2. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).
- E. Runner Tracks: Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches (51 mm) long and in depth matching studs.
 - 1. Minimum Base-Metal Thickness: Matching steel studs.
- F. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dietrich Metal Framing; The System by Metal-Lite, Inc.
 - b. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.

- G. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches (76 mm), in depth matching studs, and not less than 0.0329 inch (0.84 mm) thick.
- H. Room-Side Finish: As indicated.
- I. Shaft-Side Finish: As indicated.
- J. Insulation: Sound attenuation blankets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to which gypsum board shaft-wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft-wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft-wall assemblies to comply with requirements specified in Division 07 Section "Applied Fireproofing."
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runner tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft-wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

- A. General: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:
 - 1. ASTM C 754 for installing steel framing except comply with framing spacing indicated.
 - 2. Division 09 Section "Gypsum Board Assemblies" for applying and finishing panels.
 - 3. Division 09 Section "Tiling" for cementitious backer units.

- B. Do not bridge architectural or building expansion joints with shaft-wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.
 - 1. At elevator hoistway entrance door frames, provide jamb struts on each side of door frame.
 - 2. Where handrails directly attach to gypsum board shaft-wall assemblies, provide galvanized steel reinforcing strip with 0.0312-inch (0.79-mm) minimum thickness of base (uncoated) metal, accurately positioned and secured behind at least 1 gypsum board or cementitious backer unit face-layer panel.
- D. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect and as indicated on the drawings, while maintaining fire-resistance rating of gypsum board shaft-wall assemblies.
- H. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with ASTM C 919 requirements or with manufacturer's written instructions, whichever are more stringent.
- I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3mm) from the plane formed by faces of adjacent framing.

3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092116

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:
 - 1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
 - 2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).
- B. Related Sections include the following:
 - 1. Division 05 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; roof rafters and ceiling joists.
 - 2. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall joint systems installed with non-load-bearing steel framing.
 - 3. Division 09 Section "Gypsum Board Shaft-Wall Assemblies" for non-load-bearing metal shaft-wall framing, gypsum panels, and other components of shaft-wall assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
2. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Postinstalled, chemical anchor or Postinstalled, expansion anchor.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2-inch- (12.7-mm-) wide flanges.
 1. Depth: 2-1/2 inches (64 mm) or as indicated on Drawings.
- E. Furring Channels (Furring Members):
 1. Cold-Rolled Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges, 3/4 inch (19.1 mm) deep.
 2. Steel Studs: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).
 - b. Depth: As indicated on Drawings.
 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.
 - a. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 4. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.
- F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; 640-C.
 - c. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm) typical; 0.0428 inch (1.09 mm) minimum at fire door frames and ceramic tile substrates.
 - 2. Depth: As indicated on Drawings.
- B. Slip-Type Head Joints: Provide the following:
 - 1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.0312-inch (0.79-mm).
- E. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 - 2. Depth: As indicated on Drawings.
- G. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.
 - 1. Configuration: Asymmetrical or hat shaped.
- H. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch (0.79 mm).
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.
- I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare-metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (600 mm) o.c.
 - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.

- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
 - 1. Space studs as follows:
 - a. Single-Layer Application: 24 inches (610 mm) o.c., unless otherwise indicated.
 - b. Multilayer Application: 16 inches (406 mm) o.c., unless otherwise indicated.
 - c. Tile backing panels: 16 inches (406 mm) o.c., unless otherwise indicated.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb, unless otherwise indicated.
 - b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- D. Direct Furring:
 - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- E. Z-Furring Members:

1. Erect insulation (specified in Division 07 Section "Thermal Insulation") vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092600 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum board.
 - 2. Exterior gypsum board for ceilings and soffits.
 - 3. Tile backing panels.
- B. Related Sections include the following:
 - 1. Division 05 Section "Cold-Formed Metal Framing" for load-bearing steel framing that supports gypsum board.
 - 2. Division 06 Section "Sheathing" for gypsum sheathing.
 - 3. Division 07 Section "Thermal Insulation" for insulation installed in assemblies that incorporate gypsum board.
 - 4. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board.
 - 5. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
 - 6. Division 09 Section "Gypsum Board Shaft-Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
 - 7. Division 09 Section "Tiling" for other materials and installation of tiled finishes.
 - 8. Division 09 painting sections for primers applied to gypsum board surfaces.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
- C. LEED Submittals:
 - 1. Product Data for Credit EQ 4.1: For adhesives used to laminate gypsum board panels to substrates, including printed statement of VOC content.

2. Product Data for Credit MR 4.1, MR 4.2 and MR 5.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content and location of extraction, processing and manufacturing.
 - a. Include statement indicating costs for each product having recycled content.

1.4 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Install mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 3. Simulate finished lighting conditions for review of mockups.
 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. G-P Gypsum.
 - b. Lafarge North America.
 - c. National Gypsum Company.
 - d. USG Corporation.

- B. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

- C. Abuse-Resistant Type: Manufactured in accordance with ASTM D 5420, ASTM D 4977 and ASTM E 695 to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than standard, regular-type and Type X gypsum board.

1. Core: 5/8 inch (15.9 mm), Type X unless indicated otherwise.
2. Long Edges: Tapered.

- D. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.

2.3 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Exterior Gypsum Soffit Board: ASTM C 931/C 931M or ASTM C 1396/C 1396M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. G-P Gypsum.
- b. Lafarge North America.
- c. National Gypsum Company.
- d. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X unless indicated otherwise.

B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M.

1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum.
2. Core: 5/8 inch (15.9 mm), Type X unless indicated otherwise.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, in maximum available lengths to minimize end-to-end butt joints.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. C-Cure; C-Cure Board 990.
 - b. Custom Building Products; Wonderboard.
 - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
3. Thickness: 1/2 inch (12.7 mm).

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.

B. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.

c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
3. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Ceiling Type: Ceiling and soffit surfaces.
 - 2. Abuse-Resistant, Type X: Typical at all walls unless indicated otherwise.
 - 3. Cementitious Backer Units/Glass-Mat, Water-Resistant Backing Board: At walls scheduled to receive tile and shower room walls.
- B. Single-Layer Application:
 - 1. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 2. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:

1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 2. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- E. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
 2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
1. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at showers, locations indicated to receive tile and other locations as indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
- B. Cementitious Backer Units: ANSI A108.11, at showers, locations indicated to receive tile and where indicated.
- C. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.
- D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. L-Bead: Use at exposed panel edges.
 - 4. U-Bead: Use at exposed panel edges or where indicated.
- D. Exterior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
- E. Aluminum Trim: Install in locations indicated on Drawings.

3.7 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
 - 4. Level 5: Where indicated on Drawings.
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092600

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Ceramic tile.

- B. Related Sections:

- 1. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
- 2. Division 09 Section "Gypsum Board" for cementitious backer units and glass-mat, water-resistant backer board.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
 - 1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
- C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches (300 mm) square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.

E. Qualification Data: For qualified Installer.

F. Product Certificates: For each type of product, signed by product manufacturer.

G. Material Test Reports: For each tile-setting and -grouting product.

1.5 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type from one source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:

1. Joint sealants.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Build mockups in locations as designated by Architect.

1. Build mockup of each type of wall tile installation.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
 - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS (PT-1 and SM-1):

- A. Basis-of-Design Products: The design for tile products is based on products indicated. Subject to compliance with requirements, provide the named products or comparable products by one of the alternate manufacturers indicated.
- B. Tile Type: Glazed wall tile PT-1
1. Basis-of-Design Product: Subject to compliance with requirements, provide basis of design as indicated on Drawings or comparable product by one of the following:
 - a. Dal-tile
 - b. American Marazzi Tile, Inc.
 - c. American Olean
 - d. Florida Tile Industries, Inc.
 - e. Florim USA.
 - f. Portobello America, Inc.
 - g. Seneca Tiles, Inc.
 - h. United States Ceramic Tile Company.
 2. Face Size:
 - a. As indicated.
 3. Face: Pattern of design indicated, with manufacturer's standard edges.
 4. Grout Color: As selected by Architect from manufacturer's full range.
 5. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.
 - b. Base: As indicated in drawings.
- C. Tile Type: Stone Mosaic Tile SM-1
1. Basis-of-Design Product: Subject to compliance with requirements, provide basis of design as indicated on Drawings. Subject to design intent and conformance with specifications, products of other manufacturers may be submitted for approval in accordance with General Conditions of the project and Division 01 requirements.
 2. Face Size:
 - a. As indicated.
 3. Face: Pattern of design indicated, with manufacturer's standard edges.
 4. Grout Color: As selected by Architect from manufacturer's full range.
 5. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.3 ACCESSORIES

A. Finishing Profiles for Walls

1. Basis-of-Design Products: The design for tile products is based on products indicated. Subject to compliance with requirements, provide the named products or comparable products by an alternate manufacturer.
 - a. Schluter Systems, L.P., 194 Pleasant Ridge Road, Plattsburgh, NY 12901-5841. Tel.: (800) 472-4588.
 - 1) Product: Schluter®-JOLLY
 - 2) Description: L-shaped profile with 1/8 inch (3.2 mm) wide top section and vertical wall section that together form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 3) Material and Finish: Polished Chrome Anodized Aluminum

2.4 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Laticrete International, Inc.
 - g. MAPEI Corporation.
 - h. Mer-Kote Products, Inc.
 - i. Southern Grouts & Mortars, Inc.
 - j. TEC; a subsidiary of H. B. Fuller Company.
2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.5 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Laticrete International, Inc.

- g. MAPEI Corporation.
- h. Southern Grouts & Mortars, Inc.
- i. TEC; a subsidiary of H. B. Fuller Company.

- 2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

2.6 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."
 - 1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. DAP Inc.; 100 percent Silicone Kitchen and Bath Sealant.
 - b. Dow Corning Corporation; Dow Corning 786.
 - c. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
 - d. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
 - e. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
 - f. Tremco Incorporated; Tremsil 600 White.
- D. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bostik, Inc.; Chem-Calk 550.
 - b. Degussa Building Systems; Sonneborn Sonolastic SL 2.
 - c. Pecora Corporation; Dynatrol II-SG.
 - d. Sika Corporation; Sikaflex-2c SL.
 - e. Tremco Incorporated.; THC-900.

2.7 MISCELLANEOUS MATERIALS

- A. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 - 1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.8 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- B. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series

"Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay tile in pattern indicated on drawings. If pattern is not otherwise indicated lay tile in grid pattern. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Glazed Wall Tile: 1/16 inch (1.6 mm).
 - 2. Decorative Thin Wall Tile: 1/16 inch (1.6 mm).
- F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.4 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove latex-portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.5 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Masonry or Concrete:

- 1. Tile Installation W202: Thin-set mortar; TCA W202.
 - a. Tile Type: Porcelain wall tile.
 - b. Thin-Set Mortar: Latex-portland cement mortar.
 - c. Grout: Polymer-modified unsanded grout.

B. Interior Wall Installations, Metal Studs or Furring:

- 1. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA W244.
 - a. Tile Type: Porcelain wall tile.
 - b. Thin-Set Mortar: Latex-portland cement mortar.
 - c. Grout: Polymer-modified unsanded grout.
- 2. Tile Installation W245: Thin-set mortar on coated glass-mat, water-resistant gypsum backer board; TCA W245.
 - a. Tile Type: Porcelain wall tile.
 - b. Thin-Set Mortar: Latex-portland cement mortar.
 - c. Grout: Polymer-modified unsanded grout.

C. Shower Receptor and Wall Installations, Concrete or Masonry:

- 1. Tile Installation B421: Thin-set mortar on waterproof membrane; TCA B421.
 - a. Tile Type: Porcelain wall tile.
 - b. Thin-Set Mortar: Latex-portland cement mortar.
 - c. Grout: Polymer-modified unsanded grout.

D. Shower Receptor and Wall Installations, Metal Studs or Furring:

- 1. Tile Installation B415: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA B415.
 - a. Tile Type: Porcelain wall tile.
 - b. Thin-Set Mortar: Latex- portland cement mortar.
 - c. Grout: Polymer-modified unsanded grout.
- 2. Tile Installation B420: Thin-set mortar on coated glass-mat, water-resistant backer board; TCA B420.
 - a. Tile Type: Porcelain wall tile.

- b. Thin-Set Mortar: Latex-portland cement mortar.
- c. Grout: Polymer-modified unsanded grout.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension system members.
 - 2. Method of attaching hangers to building structure.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch- (150-mm-) square samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long samples of each type, finish, and color.
- D. LEED Submittals:
 - 1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.

2. Product Data for Credit EQ 4.1: For sealants, including printed statement of VOC content.
 - E. Qualification Data: For testing agency.
 - F. Field quality-control test reports.
 - G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
 - H. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.
 - I. Maintenance Data: For finishes to include in maintenance manuals.
 - J. Source Limitations:
 1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
 2. Suspension System: Obtain each type through one source from a single manufacturer.
 - K. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - b. Identify materials with appropriate markings of applicable testing and inspecting agency.
 2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
 - L. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 2. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
 - M. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 - N. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they

will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A and Class B materials.
 - 2. Smoke-Developed Index: 450 or less.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.

- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
- C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (ACT-1):

- A. Basis-of-Design Product: Subject to compliance with requirements, provide "Dune" as manufactured by Armstrong World Industries or a comparable product by one of the following:
 - 1. BPB USA
 - 2. Chicago Metallic Corporation
 - 3. Ecophon CertainTeed, Inc.
 - 4. Tectum Inc.
 - 5. USG Interiors, Inc.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
 - 2. Pattern: CE (perforated, lightly textured).
- C. Color: White.
- D. LR: 0.83.
- E. NRC: 0.50.
- F. Edge/Joint Detail: Square Tegular 9/16 inch.
- G. Thickness: 5/8-inch (15.9 mm).
- H. Modular Size: 24 by 48 inches (610 by 1220 mm) and as indicated on the drawings.
- I. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.

2.4 ACOUSTICAL PANELS FOR ACOUSTICAL SHAPE CEILING (ACC-1):

- A. Basis-of-Design Product: Subject to compliance with requirements, provide "Soundscape Shapes," custom size and shape as manufactured by Armstrong World Industries or a comparable product by one of the following:
 - 1. BPB USA
 - 2. Chicago Metallic Corporation
 - 3. Ecophon CertainTeed, Inc.
 - 4. Tectum Inc.
 - 5. USG Interiors, Inc.
- B. Shapes: As indicated on drawings.

- C. Classification: Provide fabric wrapped panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type XII, fiberglass, glass reinforced.
 - 2. Form 2.
 - 3. Pattern: E.
- D. Color: As indicated on drawings.
- E. LR: 0.90.
- F. Edge/Joint Detail: Square finished.
- G. Thickness: 7/8-inch
- H. Modular Size: Custom.

2.5 ACOUSTICAL PANELS FOR ACOUSTICAL SHAPE CEILING (ACC-2):

- A. Basis-of-Design Product: Subject to compliance with requirements, provide “Soundscape Shapes – Circular #5443” as manufactured by Armstrong World Industries or a comparable product by one of the following:
 - 1. BPB USA
 - 2. Chicago Metallic Corporation
 - 3. Ecophon CertainTeed, Inc.
 - 4. Tectum Inc.
 - 5. USG Interiors, Inc.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type XII, fiberglass, glass reinforced with factory applied painted finish on acoustically transparent membrane.
 - 2. Form 2.
 - 3. Pattern: E.
- C. Color: White.
- D. LR: 0.90.
- E. Edge/Joint Detail: Square finished.
- F. Thickness: 7/8-inch
- G. Modular Size: Circular – 34 inch nominal diameter

2.6 ACOUSTICAL PANELS FOR ACOUSTICAL SHAPE CEILING (ACC-3 & ACC-4):

- A. Basis-of-Design Product: Subject to compliance with requirements, provide “Soundscape Shapes - Trapezoid” as manufactured by Armstrong World Industries or a comparable product by one of the following:
 - 1. BPB USA

2. Chicago Metallic Corporation
 3. Ecophon CertainTeed, Inc.
 4. Tectum Inc.
 5. USG Interiors, Inc.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
1. Type and Form: Type XII, fiberglass, glass reinforced with factory applied painted finish on acoustically transparent membrane.
 2. Form 2.
 3. Pattern: E.
- C. Color: As indicated on drawings.
- D. LR: 0.90.
- E. Edge/Joint Detail: Square finished.
- F. Thickness: 7/8-inch
- G. Modular Size: Trapezoid – 34 inches by 46 inches

2.7 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Postinstalled expansion or Postinstalled bonded anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

- F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.
- I. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

2.8 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILINGS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Interlude 9/16" Exposed Tee System at Acoustical Ceiling Panel type **ACT-1** or a comparable product by one of the following:
 - 1. BPB USA.
 - 2. Chicago Metallic Corporation.
 - 3. Ecophon CertainTeed, Inc.
 - 4. USG Interiors, Inc.

2.9 METAL SUSPENSION SYSTEM FOR ACOUSTICAL SHAPE CEILINGS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Individual Attachment to Drywall with Concealed Hardware at Acoustical Shape Ceiling types ACC-1 or a comparable product by one of the following:
 - 1. BPB USA.
 - 2. Chicago Metallic Corporation.
 - 3. Ecophon CertainTeed, Inc.
 - 4. USG Interiors, Inc.
- B.
- C. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Individual Suspension with Concealed Hardware at Acoustical Shape Ceiling types ACC-2, ACC-3 and ACC-3 or a comparable product by one of the following:
 - 1. BPB USA.
 - 2. Chicago Metallic Corporation.
 - 3. Ecophon CertainTeed, Inc.
 - 4. USG Interiors, Inc.

2.10 METAL EDGE MOLDINGS AND TRIM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. BPB USA.
 - 3. Chicago Metallic Corporation.
 - 4. Fry Reglet Corporation.
 - 5. Gordon, Inc.

6. USG Interiors, Inc.

- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
 2. Provide manufacturer's standard stepped edge reveal (shadow) molding.
 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.11 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 7. Do not attach hangers to steel deck tabs.
 8. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.

4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
5. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
6. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 095450 - SPECIALTY CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes specialty wood plank and polycarbonate panels and suspension systems for ceilings.

1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension system members.
 - 2. Method of attaching hangers to building structure.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels and special moldings.
 - 4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Panels: Set of 6-inch- (150-mm-) square samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long samples of each type, finish, and color.
- D. LEED Submittals:

1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
 2. Product Data for Credit EQ 4.1: For sealants, including printed statement of VOC content.
- E. Qualification Data: For testing agency.
- F. Field quality-control test reports.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each panel ceiling.
- H. Research/Evaluation Reports: For each panel ceiling and components and anchor and fastener type.
- I. Maintenance Data: For finishes to include in maintenance manuals.
- J. Source Limitations:
1. Ceiling Panel: Obtain each type through one source from a single manufacturer.
 2. Suspension System: Obtain each type through one source from a single manufacturer.
- K. Fire-Test-Response Characteristics: Provide panel ceilings that comply with the following requirements:
1. Fire-Resistance Characteristics: Where indicated, provide panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - b. Identify materials with appropriate markings of applicable testing and inspecting agency.
 2. Surface-Burning Characteristics: Provide panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
- L. Seismic Standard: Provide panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 2. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
- M. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- N. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

- A. Coordinate layout and installation of panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A and Class B materials.
 - 2. Smoke-Developed Index: 450 or less.

2.2 PANELS, GENERAL

- A. Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
- B. Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

2.3 WOOD PLANK CEILING (WPC-1):

- A. Basis-of-Design Product: Subject to compliance with requirements, provide "Woodworks" as manufactured by Armstrong World Industries or a comparable product by one of the following:
 - 1. BPB USA
 - 2. Chicago Metallic Corporation
 - 3. Ecophon CertainTeed, Inc.
 - 4. Tectum Inc.
 - 5. USG Interiors, Inc.
- B. Classification: Provide panels complying with ASTM E 1264 for fire Class A.
- C. Style: 6440W1412
- D. Color: Natural Variations Maple.
- E. NRC: 0.50.
- F. Edge/Joint Detail: Conceal integral clips.
- G. Thickness: 3/4-inch.
- H. Modular Size: 8'-0" x 3 3/4" and as indicated on the drawings.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
 - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per

ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

- a. Type: Postinstalled expansion or Postinstalled bonded anchors.
- b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.

- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure panels in-place.
- I. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.
- J. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including manufacturer's standard antimicrobial gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

2.5 METAL SUSPENSION SYSTEMS"

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong 12'-0" HD Linear Carriers (concealed) with integral clips Wood Plank type WPC-1 or a comparable product by one of the following:
1. BPB USA.
 2. Chicago Metallic Corporation.
 3. Ecophon CertainTeed, Inc.
 4. USG Interiors, Inc.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Armstrong World Industries, Inc.
 2. BPB USA.
 3. Chicago Metallic Corporation.

4. Fry Reglet Corporation.
5. Gordon, Inc.
6. USG Interiors, Inc.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
2. Provide manufacturer's standard stepped edge reveal (shadow) molding.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of panel ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 7. Do not attach hangers to steel deck tabs.
 8. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of ceiling area and where necessary to conceal edges of panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
3. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by panel manufacturer.
5. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
6. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.

3.4 CLEANING

- A. Clean exposed surfaces of panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095450

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Resilient base.
- 2. Resilient stair accessories.
- 3. Resilient molding accessories.

- B. Related Sections:

- 1. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. LEED Submittals:

- 1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content and chemical components.

- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

- D. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

- 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

- B. Mockups: Provide resilient products with mockups specified in other Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE (RB-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide resilient base as manufactured by Johnsonite or a comparable product by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - c. Flexco, Inc.
 - d. Roppe Corporation, USA.
- B. Resilient Base Standard: ASTM F 1861.
 - 1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe) unless indicated otherwise; Straight (flat or toeless) at carpet flooring.

- C. Minimum Thickness: 0.125 inch (3.2 mm).
- D. Height: 4 inches (102 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Finish: Satin.
- I. Colors and Patterns: As indicated on Finish Schedule.

2.2 RESILIENT STAIR ACCESSORIES (RT-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Resilient Stair Treads as manufactured by Johnsonite or a comparable product by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - c. Flexco, Inc.
 - d. Roppe Corporation, USA.
- B. Resilient Stair Treads Standard: ASTM F 2169.
 - 1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
 - 2. Surface Design:
 - a. Class 2, Pattern: Raised-disc design.
 - 3. Manufacturing Method: Group 1, tread with embedded abrasive strips.
- C. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
- D. Nosing Height: 1-1/2 inches (38 mm).
- E. Thickness: 1/4 inch (6 mm).
- F. Size: Lengths and depths to fit each stair tread in one piece.
- G. Risers: Smooth, flat, integral with tread.
 - 1. Thickness: 0.125 inch (3.2 mm).
- H. Stringers: Of same thickness as risers, height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- I. Colors and Patterns: As indicated on Finish Schedule.

2.3 RESILIENT MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - b. Flexco, Inc.
 - c. Johnsonite.
 - d. R.C.A. Rubber Company (The).
 - e. Roppe Corporation, USA.
 - f. VPI, LLC; Floor Products Division.
- B. Description: Reducer and Transition strips.
- C. Material: Vinyl or rubber.
- D. Profile and Dimensions:
 - a. VCT to carpet: Match Johnsonite profile CTA-XX-D.
 - b. VCT to concrete: Match Johnsonite profile RRS-XX-D.
 - c. VCT to tile: Match Johnsonite profile CTA-XX-K.
 - d. VCT to sheet vinyl: Match Johnsonite profile CTA-XX-N.
 - e. Carpet to tile: Match Johnsonite profile CCA-XX.
 - f. Carpet to sheet vinyl: Match Johnsonite profile CTA-XX-D.
 - g. Carpet to concrete: Match Johnsonite profile EG-XX-G.
- E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Cove Base Adhesives: Not more than 50 g/L.
 - b. Rubber Floor Adhesives: Not more than 60 g/L.
- C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.

- D. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
 - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
 - 1. Apply three coat(s).
- E. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Composition floor tile
- 2. Rubber floor tile

- B. Related Sections:

- 1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
- 2. Division 09 Section "Linoleum Flooring" for linoleum floor coverings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. LEED Submittals:

- 1. Product Data for Credit EQ 4.1: For adhesives, sealants, and chemical-bonding compounds, including printed statement of VOC content.

- C. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

- 1. Show details of special patterns.

- D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

- E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

- F. Qualification Data: For qualified Installer.

- G. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups for floor tile including resilient base and accessories.
 - a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color, and pattern in locations directed by Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 COMPOSITION FLOOR TILE (MCT-1, MCT-2 & MCT-3):

A. Basis of Design

1. Product: MARMOLEUM® COMPOSITION TILE
 - a. Color: As indicated in the drawings.
 - b. Size: 13" x 13" approx. (33.3 cm x 33.3 cm)
 - c. Gauge: .080" (2.0 mm)
 - d. Backing: Polyester

B. Tile Standard: ASTM F2195 Standard Specification for Linoleum Tile Flooring: Type I

C. Fire Testing: ASTM E 648/NFPA 253 (Critical Radiant Flux)-Class 1

D. Static Load Limit: 1500 Pounds per square inch when tested in accordance with ASTM F 970-00, Standard Test Method for Static Load Limit.

E. Slip Resistance: MCT meets or exceeds A.D.A. recommendation of .6 for flat surfaces when tested in accordance with ASTM D 2047.

F. Castor Resistance: EN 425 - Suitable for office chairs with castors

G. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

- a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

2.3 RUBBER FLOOR TILE (RT-2)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Rubber Flooring as manufactured by Nora or a comparable product by one of the following:

1. Endura Rubber Flooring, a division of Burke Industries Inc.
 2. Flexco.
 3. R.C.A. Rubber Company (The).
 4. Roppe Corporation, USA.
 5. Johnsonite
- B. Tile Standard: ASTM F 1344, Class I-A, homogeneous rubber tile, solid color.
- C. Hardness: Manufacturer's standard hardness.
- D. Wearing Surface: Molded pattern.
1. Molded-Pattern Figure: Raised discs.
- E. Thickness: 0.125 inch (3.2 mm).
- F. Size: 24 by 24 inches (610 by 610 mm).
- G. Colors and Patterns: As indicated on Finish Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

- a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are same temperature as space where they are to be installed.
1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
1. Lay tiles square with room axis unless indicated otherwise.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern) unless otherwise indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, pipes, outlets, and door frames.
1. Lay tile wall below casework.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096600 - RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Thin-set epoxy-resin terrazzo flooring.
- 2. Precast terrazzo units.

- B. Related Sections:

- 1. Division 03 Section "Cast-In-Place Concrete" for concrete slabs.
- 2. Division 07 Section "Joint Sealants" for sealants installed with terrazzo.
- 3. Division 09 Section "Gypsum Board" for walls abutting terrazzo.

1.3 SUBMITTALS

- A. Product Data: For each type of terrazzo flooring and precast terrazzo product indicated.

- B. LEED Submittals:

- 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For marble chips, aggregates, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

- a. Include statement that indicates cost for each product having recycled content.

- 2. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.

- C. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:

- 1. Divider strips.
- 2. Control-joint strips.
- 3. Accessory strips.
- 4. Abrasive strips.
- 5. Stair treads, risers, and landings.
- 6. Precast terrazzo jointing and edge configurations.
- 7. Terrazzo patterns.

- D. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each

terrazzo sample to identify manufacturer's matrix color, marble-chip and aggregate types, sizes, and proportions. Prepare samples of same thickness and from same material to be used for the Work in size indicated below:

1. Terrazzo: 6-inch- (150-mm-) square Samples.
 2. Precast Terrazzo: 6-inch- (150-mm-) square Samples.
 3. Accessories: 6-inch- (150-mm-) long Samples of each exposed strip item required.
- E. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- F. Qualification Data: For qualified Installer.
- G. Material Certificates: For each type of terrazzo material or product, from manufacturer.
- H. Maintenance Data: For terrazzo to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who is acceptable to terrazzo manufacturer to install manufacturer's products.
1. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
 2. Engage an installer who is a contractor member of NTMA.
- B. Source Limitations: Obtain primary terrazzo materials from one source from a single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- C. Source Limitations for Marble Chips and Aggregates: Obtain each color, grade, type, and variety of granular materials from one source with resources to provide materials of consistent quality in appearance and physical properties.
- D. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups for terrazzo including accessories.
 - a. Size: Minimum 100 sq. ft. (9 sq. m) of typical poured-in-place flooring condition for each color and pattern in locations directed by Architect.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to terrazzo including, but not limited to, the following:

- a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
- b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- c. Review special terrazzo designs and patterns.
- d. Review dust-control procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- E. Control and collect dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.
 1. Provide dustproof partitions and temporary enclosures to limit dust migration and to isolate areas from noise.

PART 2 - PRODUCTS

2.1 EPOXY-RESIN TERRAZZO (TRZ-1, TRZ-2, TRZ-3 and TRZ-4)

- A. Products: Subject to compliance with requirements, provide one of the following:
 1. Terrazzo & Marble Supply Companies; Terroxy Resin Systems.
 2. Crossfield Products Corp., Dex-O-Tex Division; Cheminert Terrazzo.
 3. General Polymers Corporation (Sherwin Williams); Terrazzo 1100.
 4. Key Resin Company; Key Epoxy Terrazzo.
 5. Master Terrazzo Technologies LLC; Morricite.
 6. TEC Specialty Construction Brands, Inc.; Tuff-Lite Epoxy Terrazzo.

- B. Materials:

1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate crack preparation and reflective crack reduction.
 - a. Reinforcement: Fiberglass scrim.
2. Primer: Manufacturer's product recommended for substrate and use indicated.
3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.
 - a. Physical Properties without Marble Chips and Aggregates:
 - 1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
 - 2) Minimum Tensile Strength: 3000 psi (20.7 MPa) per ASTM D 638 for a 2-inch (51-mm) specimen made using a "C" die per ASTM D 412.
 - 3) Minimum Compressive Strength: 10,000 psi (6.9 MPa) per ASTM D 695, Specimen B cylinder.
 - 4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
 - a) Distilled water.
 - b) Mineral water.
 - c) Isopropanol.
 - d) Ethanol.
 - e) 0.025 percent detergent solution.
 - f) 1.0 percent soap solution.
 - g) 10 percent sodium hydroxide.
 - h) 10 percent hydrochloric acid.
 - i) 30 percent sulfuric acid.
 - j) 5 percent acetic acid.
4. Marble Chips and Aggregates: Complying with NTMA gradation standards for mix indicated and containing no deleterious or foreign matter.
 - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
 - b. 24-Hour Absorption Rate: Less than 0.75 percent.
 - c. Dust Content: Less than 1.0 percent by weight.

5. Finishing Grout: Resin based.

C. Terrazzo: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and marble-chip proportions and mixing.

1. Formulated Mix Color and Pattern: As selected by Architect from manufacturer's full range.

2.2 STRIP MATERIALS

A. Thin-Set Divider Strips: L-type angle or T-type, 1/4 inch (6.4 mm) deep.

1. Material: Aluminum. Where divider strip abuts steel structure or steel edge angles, provide stainless steel.
2. Top Width: 1/8 inch (3.2 mm).

- B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material, thickness, and color of divider strips and in depth required for topping thickness indicated.
- C. Accessory Strips: Match divider strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
 - 1. Base-bead strips for exposed top edge of terrazzo base.
 - 2. Edge-bead strips for exposed edges of terrazzo.
 - 3. Nosings for terrazzo stair treads and landings.
- D. Abrasive Strips: Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
 - 1. Width: 1/2 inch (12.7 mm).
 - 2. Depth: As required by terrazzo thickness.
 - 3. Length: 4 inches (100 mm) less than stair width.
 - 4. Color: As selected by Architect from manufacturer's full range.

2.3 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use and acceptable to terrazzo manufacturer.
 - 1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Anchoring Devices:
 - 1. Strips: Provide mechanical anchoring devices for strip materials as required for secure attachment to substrate.
 - 2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
- C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- E. Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- F. Sealer: Slip- and stain-resistant penetrating-type sealer that is chemically neutral with pH factor between 7 and 10; does not affect color or physical properties of terrazzo; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.

2.4 PRECAST TERRAZZO UNITS

- A. Precast Terrazzo Base Units: 1/4 inch (6.4 mm) thick; cast in maximum lengths possible, but not less than 36 inches (900 mm); with rounded, finished top edge.

1. Type: Coved with minimum 3/4-inch (19-mm) radius.
2. Height: 4 inches (101 mm).
3. Outside Corner Units: With finished returned edges at outside corner.
4. Color, Pattern, and Finish: Match adjacent poured-in-place terrazzo flooring.

B. Precast Terrazzo Finishing:

1. Finish exposed-to-view edges or reveals to match face finish.
2. Ease exposed edges to 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
- B. Concrete Slabs:
 1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
 - c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
 2. Verify that concrete substrates are visibly dry and free of moisture.
 3. Moisture Testing:
 - a. Test for moisture content by method recommended in writing by terrazzo manufacturer. Proceed with installation only after substrates pass testing.
- C. Protect other work from dust generated by grinding operations. Control dust to prevent air pollution and comply with environmental protection regulations.
 1. Erect and maintain temporary enclosures and other suitable methods to limit dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.
- D. Installation of terrazzo indicates acceptance of surfaces and conditions.

3.3 EPOXY-RESIN TERRAZZO INSTALLATION

A. General:

1. Comply with NTMA's written recommendations for terrazzo and accessory installation.
2. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."
3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet (6 mm in 3 m); noncumulative.
4. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
5. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

B. Thickness: 3/8 inch (9.5 mm) nominal.

C. Flexible Reinforcing Membrane:

1. Prepare and prefill substrate cracks with membrane material.
2. Install membrane to produce full substrate coverage in areas to receive terrazzo.
3. Reinforce membrane with fiberglass scrim.
4. Prepare membrane according to manufacturer's written instructions before applying substrate primer.

D. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.

E. Strip Materials:

1. Divider and Control-Joint Strips:

- a. Locate divider strips in locations indicated and as required by manufacture.
- b. Install control-joint strips back to back directly above concrete-slab control joints.
- c. Install control-joint strips with 1/4-inch (6.4-mm) gap between strips, and install sealant in gap.
- d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

2. Accessory Strips: Install accessory strips in locations indicated and as required to provide a complete installation.

3. Abrasive Strips: Install with surface of abrasive strip positioned maximum 1/16 inch (1.6 mm) higher than terrazzo surface.

F. Fine Grinding: Grind with stones 120 grit or finer until all grout is removed from surface. Repeat rough grinding, grout coat, and fine grinding if large voids exist after initial fine grinding. Produce surface with a minimum of 70 percent aggregate exposure.

G. Repair: Remove and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.4 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo units using method recommended NTMA and manufacturer unless otherwise indicated.
- B. Installation Tolerance: Set units with alignment level and true to dimensions, varying 1/8-inch (3.2-mm) maximum in length, height, or width; noncumulative.
- C. Do not install units that are chipped, cracked, discolored, or not properly finished.
- D. Seal joints between units with joint compound matching precast terrazzo matrix.

3.5 CLEANING AND PROTECTION

- A. Cleaning:
 - 1. Remove grinding dust from installation and adjacent areas.
 - 2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow drying thoroughly.
- B. Sealing:
 - 1. Seal surfaces according to NTMA's written recommendations.
 - 2. Apply sealer according to sealer manufacturer's written instructions.
- C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 096600

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes resinous flooring systems with epoxy body coat(s) at Mechanical Room 203.
 - 1. Application Method: Troweled.
- B. Related Sections include the following:
 - 1. Division 07 Section "Joint Sealants" for sealants installed at joints in resinous flooring systems.
 - 2. Division 09 Section "Resinous Matrix Terrazzo Flooring" for thin-set, resinous terrazzo.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.
- C. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings.
- D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- E. Material Test Reports: For each resinous flooring component.
- F. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who employs only persons trained and approved by resinous flooring manufacturer for applying resinous flooring systems indicated.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Apply full-thickness mockups on 48-inch- (1200-mm-) square floor area selected by Architect.
 - a. Include 48-inch (1200-mm) length of integral cove base.
 2. Simulate finished lighting conditions for Architect's review of mockups.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 RESINOUS FLOORING

- A. Products: Subject to compliance with requirements, provide one of the following:
 1. ChemMasters.
 2. Crossfield Products Corp., Dex-O-Tex.

3. Dur-A-Flex Inc.
4. General Polymers Corporation, a division of the Sherwin-Williams Company.
5. Micor Company, Inc.
6. Pacific Polymers, Inc.
7. Stonhard, Inc.
8. Tamms Industries, Inc.
9. Valspar, Federal Flooring Division.
10. Industrial Floor Corporation

B. System Characteristics:

1. Color and Pattern: As selected by Architect from manufacturer's full range.
2. Wearing Surface: Manufacturer's standard orange-peel texture.
3. Integral Cove Base: 4 inches (100 mm) high.
4. Overall System Thickness: 3/16 inch (4.8 mm) to 1/4 inch (6.4 mm).

C. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. Body Coat(s):
 - a. Resin: Epoxy.
 - b. Formulation Description: 100 percent solids.
 - c. Application Method: Troweled or screeded.
 - d. Aggregates: Colored quartz (ceramic-coated silica).
2. Primer: Type recommended by manufacturer for substrate and body coat(s) indicated.
3. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coat(s) indicated.
4. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coat(s) indicated and that prevents substrate cracks from reflecting through resinous flooring.
5. Topcoat: Chemical-resistant sealing or finish coat(s).
 - a. Resin: Epoxy.
 - b. Type: Clear.
 - c. Finish: Matte.
 - d. Number of Coats: One.

D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: 10,500 psi per ASTM C 579.
2. Tensile Strength: 1,800 psi per ASTM C 307.
3. Flexural Modulus of Elasticity: 4000 psi per ASTM C 580.
4. Water Absorption: <1.0% per MIL-D-3134.
5. Indentation (Steadily Applied Load): 0.005" per MIL-D-3134.
6. Indentation (Impact Load): 0.011" per MIL-D-3134.
7. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch (1.6 mm) per MIL-D-3134.

8. Abrasion Resistance: 0.04 gr maximum weight loss per ASTM D 4060.
9. Flammability: Self-extinguishing per ASTM D 635.
10. Hardness: 80-85, Shore D per ASTM D 2240.

2.2 ACCESSORY MATERIALS

- A. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- B. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.
 1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 1. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
 2. Verify that concrete substrates are dry.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab in 24 hours.
 - b. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
 - c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
 3. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.2 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - 3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
 - a. Apply joint sealant to comply with manufacturer's written recommendations.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply waterproofing membrane in manufacturer's recommended thickness.
 - 1. Apply waterproofing membrane to integral cove base substrates.
- D. Apply reinforcing membrane to entire substrate surface.
- E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
- F. Apply troweled or screeded body coat(s) in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
- G. Apply grout coat, of type recommended by resinous flooring manufacturer to fill voids in surface of final body coat and to produce wearing surface indicated.
- H. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 CLEANING AND PROTECTING

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes modular, tufted carpet tile.
- B. Related Sections include the following:
 - 1. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.
 - 9. Type, color, and location of edge, transition and other accessory strips.
 - 10. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long samples.
- D. LEED Submittal:
 - 1. Product Data for Credit EQ 4.3:
 - a. For carpet tile, documentation indicating compliance with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.
 - b. For installation adhesive, including printed statement of VOC content.
- E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

- F. Qualification Data: For Installer.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- H. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- I. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Mockups: Before installing carpet tile, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - 1. Review delivery, storage, and handling procedures.
 - 2. Review ambient conditions and ventilation procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.7 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Shaw products as indicated or a comparable product by one of the following manufacturers:
 - 1. Lees.
 - 2. C & A.
 - 3. Interface.
 - 4. Milliken.

2.2 CARPET TILE (CPT-1, CPT-2, CPT-3, CPT-4 and CPT-5)

- A. Products: As indicated on the drawings.
- B. Applied Soil-Resistance Treatment: Manufacturer's standard..
- C. Antimicrobial Treatment: Manufacturer's standard.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 - 1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 097723 - FABRIC-WRAPPED PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes shop-fabricated, fabric-wrapped panel units tested for acoustical performance, including:
 - 1. Sound-absorbing, fabric-wrapped wall panels.
- B. Related Sections:
 - 1. Division 09 Section "Wall Coverings" for adhesively applied textile wall coverings.

1.3 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.4 SUBMITTALS

- A. Product Data: For each type of fabric facing, wood veneer, panel edge, core material, and mounting indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Certificates for Credit MR 7: Chain-of-custody certificates indicating that wood-based products used in sound-absorbing wall units comply with forest certification requirements. Include statement indicating cost for each certified wood product.
 - 3. Product Data for Credit EQ 4.1: For installation adhesives, documentation including printed statement of VOC content and chemical components.
 - 4. Product Data for Credit EQ 4.4: For composite wood products used in sound-absorbing wall units, documentation indicating that product contains no urea formaldehyde.
- C. Shop Drawings: For sound-absorbing wall units. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge and core materials.

1. Include elevations showing panel sizes and direction of fabric weave and pattern matching.
- D. Samples for Verification: For the following products, prepared on Samples of size indicated below:
1. Fabric: Full-width by approximately 36-inch- (900-mm-) long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
 2. Panel Edge: 12-inch- (300-mm-) long Sample(s) showing each edge profile, corner, and finish.
 3. Core Material: 12-inch- (300-mm-) square Sample at corner.
 4. Mounting Devices: Full-size Samples.
 5. Assembled Panels: Approximately 36 by 36 inches (900 by 900 mm), including joints and mounting methods.
- E. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Electrical outlets, switches, and thermostats.
 2. Items penetrating or covered by sound-absorbing wall units including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Alarms.
 - e. Sprinklers.
 3. Show operation of hinged and sliding components covered by or adjacent to sound-absorbing wall units.
- F. Product Certificates: For each type of sound-absorbing wall unit, from manufacturer.
- G. Maintenance Data: For sound-absorbing wall units to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.
- H. Warranty: Sample of special warranty.
- 1.5 QUALITY ASSURANCE
- A. Source Limitations: Obtain sound-absorbing wall units from single source from single manufacturer.
- B. Fire-Test-Response Characteristics: Provide sound-absorbing wall units meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 or NFPA 286 as applicable.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials, fabrication, and installation.
 1. Build mockup of typical wall area as directed by Architect. Include intersection of wall and ceiling, corners, and perimeters.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- D. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and sound-absorbing wall unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install sound-absorbing wall units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Air-Quality Limitations: Protect sound-absorbing wall units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- C. Field Measurements: Verify locations of sound-absorbing wall units and actual dimensions of openings and penetrations by field measurements before fabrication.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-absorbing wall units that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to the following:
 - a. Acoustical performance.
 - b. Fabric sagging, distorting, or releasing from panel edge.
 - c. Warping of core.
 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACOUSTICAL WALL PANELS (AWP-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide "Soundsoak Custom Wall Panels – #5440 & 5448" as manufactured by Armstrong World Industries or a comparable product by one of the following:
 - 1. BPB USA
 - 2. Chicago Metallic Corporation
 - 3. Ecophon CertainTeed, Inc.
 - 4. Tectum Inc.
 - 5. USG Interiors, Inc.
- B. Fabric Color: TBD.
- C. LR: 0.90.
- D. Edge/Joint Detail: Square finished.
- E. Thickness: 7/8-inch
- F. Modular Size: Varies.

2.2 MATERIALS

- A. Core Materials: Manufacturer's standard.
- B. Facing Material: Fabric from same dye lot; color and pattern as indicated on Drawings.
- C. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:
 - 1. Metal Clips: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.

2.3 FABRICATION

- A. General: Use manufacturer's standard construction except as otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
 - 1. Cores: Chemically harden core edges and areas of core where mounting devices are attached.
- B. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.

- C. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
 - 1. Square Corners: Tailor corners.
 - 2. Radius and Other Nonsquare Corners: Attach facing material so there are no seams or gathering of material.
 - 3. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.
- D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:
 - 1. Thickness.
 - 2. Edge straightness.
 - 3. Overall length and width.
 - 4. Squareness from corner to corner.
 - 5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions, for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-absorbing wall units.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sound-absorbing wall units in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with sound-absorbing wall unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align and level fabric pattern and grain among adjacent units.

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus or minus 1/16 inch (1.6 mm).
- B. Variation of Panel Joints from Hairline: Not more than 1/32 inch (0.79 mm) wide.

3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.

- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 097723

SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Concrete masonry units (CMU).
3. Steel.
4. Galvanized metal.
5. Wood.
6. Gypsum board.
7. Cotton or canvas insulation covering.

- B. Related Sections include the following:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 06 Sections for shop priming carpentry with primers specified in this Section.
3. Division 09 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

- C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

- D. LEED Submittals: For Credit EQ 4.2, manufacturers' product data for paints, including printed statement of VOC content and chemical components.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 2 gal. (7.6 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Duron, Inc.
 2. Benjamin Moore & Co.
 3. M.A.B. Paints.
 4. Porter Paints.
 5. PPG Architectural Finishes, Inc.
 6. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:
 1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
 2. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
 3. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 4. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1,2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.

- m. Ethylbenzene.
- n. Formaldehyde.
- o. Hexavalent chromium.
- p. Isophorone.
- q. Lead.
- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

C. Colors: Match colors as indicated in finish/color schedules.

2.3 BLOCK FILLERS

A. Interior/Exterior Latex Block Filler: MPI #4.

- 1. VOC Content: E Range of E3.

2.4 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

- 1. VOC Content: E Range of E3.

2.5 METAL PRIMERS

A. Rust-Inhibitive Primer (Water Based): MPI #107.

- 1. VOC Content: E Range of E3.

B. Waterborne Galvanized-Metal Primer: MPI #134.

- 1. VOC Content: E Range of E3.

C. Vinyl Wash Primer: MPI #80.

- 1. VOC Content: E Range of E3.

2.6 WOOD PRIMERS

A. Interior Latex-Based Wood Primer: MPI #39.

- 1. VOC Content: E Range of E3.

2.7 LATEX PAINTS

- A. Institutional Low-Odor/VOC Latex (Low Sheen): MPI #144 (Gloss Level 2).
 - 1. VOC Content: E Range of E3.
- B. Institutional Low-Odor/VOC Latex (Eggshell): MPI #145 (Gloss Level 3).
 - 1. VOC Content: E Range of E3.
- C. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).
 - 1. VOC Content: E Range of E3.
- D. Exterior Latex (Gloss): MPI #119 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).
 - 1. VOC Content: E Range of E3.

2.8 DRY FOG/FALL COATINGS

- A. Waterborne Dry Fall: MPI #133.
 - 1. VOC Content: E Range of E3.

2.9 FLOOR COATINGS

- A. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.
 - 1. VOC Content: E Range of E3.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- I. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 2. Electrical Work:
 - a. Switchgear that does not have factory-applied final finishes.
 - b. Panelboards that do not have factory-applied final finishes..
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 - 1. Institutional Low-Odor/VOC Latex System: MPI INT 3.1M.
 - a. Prime Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss) unless indicated otherwise.
- B. Concrete Substrates, Traffic Surfaces:
 - 1. Water-Based Clear Sealer System: MPI INT 3.2G.
 - a. First Coat: Interior/exterior clear concrete floor sealer (water based).
 - b. Topcoat: Interior/exterior clear concrete floor sealer (water based).
- C. CMU Substrates:
 - 1. Institutional Low-Odor/VOC Latex System: MPI INT 4.2E.
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
- D. Steel Substrates:
 - 1. Water-Based Dry-Fall System: MPI INT 5.1C.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Topcoat: Waterborne dry fall.
 - 2. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
 - a. Prime Coat: Rust-inhibitive primer (water based).
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).

- E. Galvanized-Metal Substrates:
 - 1. Water-Based Dry-Fall System: MPI INT 5.3H.
 - a. Prime Coat: Waterborne dry fall.
 - b. Topcoat: Waterborne dry fall.
 - 2. Institutional Low-Odor/VOC Latex System: MPI INT 5.3N.
 - a. Prime Coat: Waterborne galvanized-metal primer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
 - 3. Latex System:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.
- F. Wood Panel Substrates: Including painted plywood and medium-density fiberboard.
 - 1. Institutional Low-Odor/VOC Latex System: MPI INT 6.4T.
 - a. Prime Coat: Interior latex-based wood primer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
- G. Gypsum Board Substrates:
 - 1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (eggshell).
- H. Cotton or Canvas Insulation-Covering Substrates: Including pipe and duct coverings.
 - 1. Institutional Low-Odor/VOC Latex System: MPI INT 10.1D.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (flat).

END OF SECTION 099100

SECTION 101100 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Marker boards.
- 2. Tackboards.
- 3. Projection Dry Erase Wallcovering.
- 4. Support systems for visual display boards.

- B. Related Sections:

- 1. Section 101300 "Directories" for bulletin boards within built-in directories.

1.3 DEFINITIONS

- A. Tackboard: Framed or unframed, tackable, visual display board assembly.
- B. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, marker boards, and tackboards.
- C. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, marker boards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
- C. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of panel joints.

2. Include sections of typical trim members.

D. Samples for Verification: For each type of visual display surface indicated.

1. Visual Display Surface: Not less than 8-1/2 by 11 inches (215 by 280 mm), mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.

2. Trim: 6-inch- (152-mm-) long sections of each trim profile.

E. Product Schedule: For visual display surfaces. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.

C. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.

B. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 450 or less.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate appearance and aesthetic effects and set quality standards for installation.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display surfaces completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more

pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

- B. Store visual display surfaces vertically with packing materials between each unit.
- C. Projection Dry Erase Wallcovering:
 - 1. Deliver presentation wallcoverings to the project site in unbroken and undamaged original factory packaging and clearly labeled with the manufacturer's identification label, quality or grade, and lot number.
 - 2. Store materials in a clean, dry storage area with temperature maintained above 55°F (13°C) with normal humidity.
 - 3. Store material within original packaging to prevent damage.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.
- C. Projection Dry Erase Wallcovering:
 - 1. Do not apply presentation wallcoverings when surface and ambient temperatures are outside the temperature ranges required by the wallcovering manufacturer.
 - 2. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 55°F (13°C) unless required otherwise by manufacturer's instructions.
 - 3. Apply adhesive when substrate surface temperature and ambient temperature is above 55°F (13°C) and relative humidity is below forty percent.
 - 4. Maintain constant recommended temperature and humidity for at least 72 hours prior to and throughout the installation period, and for 72 hours after wallcovering installation completion.

1.10 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: 50 years from date of Substantial Completion.
- B. Projection Dry Erase Wallcovering:

1. Submit manufacturer's limited five-year written warranty against manufacturing defects.

PART 2 - PRODUCTS

2.1 MARKER BOARD ASSEMBLIES

- A. Porcelain-Enamel Marker boards: Balanced, high-pressure, factory-laminated marker board assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch- (0.53-mm-) thick, porcelain-enamel face sheet with low-gloss finish.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. AARCO Products, Inc.
- b. ADP Lemco, Inc.
- c. Aywon.
- d. Bangor Cork Company, Inc.
- e. Best-Rite Manufacturing.
- f. Claridge Products and Equipment, Inc.
- g. Egan Visual Inc.
- h. Ghent Manufacturing, Inc.
- i. Marsh Industries, Inc.; Visual Products Group.
- j. Platinum Visual Systems; a division of ABC School Equipment, Inc.
- k. PolyVision Corporation; a Steelcase company.
- l. Tri-Best Visual Display Products.

2. Hardboard Core: 1/4 inch (6 mm) thick; with 0.005-inch- (0.127-mm-) thick, aluminum foil 0.015-inch- (0.38-mm-) thick, aluminum sheet 0.013-inch- (0.35-mm-) thick, galvanized-steel sheet backing.
3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

- B. Tempered Glass Marker boards: 1/2 inch tempered safety glass.

1. Basis-of-Design: The design for the tempered glass marker board is based on the product indicated. Subject to compliance with requirements, comparable products may be provided:

- a. Manufacturer: Skyline Design
- b. Model: Vitracolor Marker Board

2.2 TACKBOARD ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. A-1 Visual Systems.
2. AARCO Products, Inc.
3. ADP Lemco, Inc.
4. Aywon.
5. Bangor Cork Company, Inc.
6. Best-Rite Manufacturing.

7. Claridge Products and Equipment, Inc.
8. Egan Visual Inc.
9. EverProducts by Glenroy Inc.
10. Ghent Manufacturing, Inc.
11. Marsh Industries, Inc.; Visual Products Group.
12. Platinum Visual Systems; a division of ABC School Equipment, Inc.
13. PolyVision Corporation; a Steelcase company.
14. Tri-Best Visual Display Products.

- B. Plastic-Impregnated-Cork Tackboard: 1/4-inch- (6-mm-) thick, plastic-impregnated cork sheet factory laminated to 1/4-inch- (6-mm-) thick hardboard backing.

2.3 VISUAL DISPLAY WALL COVERINGS

1. Wallcoverings: Walltalkers Wallcoverings manufactured by RJF International Corporation, Fairlawn, Ohio, Projection
 - a. Dry Erase Wallcovering:
 - 1) Walltalkers erase•rite: Smooth low gloss vinyl surface for projection and dry erase markers.
 - a) ER50: 49/50 inch (1.25/1.27m) width, non-woven backing, white only.
 - 2) Accessories:
 - a) Plastic Marker Dispenser: PMD1-92: Gray plastic marker dispenser.
 - b) Aluminum Tray: Clear satin, anodized aluminum, snap-on marker and eraser tray with clips
 - c) Presentation Starter Kit (1 per room): Provide one Walltalkers starter kit containing eight dry erase markers, one eraser, two dry erase cleaning cloths, one empty bottle for water, and one 8 ounce (.23kg) bottle liquid surface cleaning solution for each room installed with dry erase wallcovering.
 - b. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall covering manufacturer.
 - 1) Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Section 099113 "Interior Painting"- and recommended in writing by wall covering manufacturer for intended substrate.

2.4 MARKER BOARD AND TACKBOARD ACCESSORIES

- A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum; standard size and shape.

1. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
2. Factory-Applied Trim: Manufacturer's standard.

B. Chalk tray: Manufacturer's standard, continuous.

2.5 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.
- C. Modular Visual Display Boards: Fabricated with integral panel clips attached to core material.
- D. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.8 VISUAL DISPLAY SURFACE SCHEDULE

- A. Visual Display Board:
 1. Marker board: Porcelain-enamel marker board assembly.
 - a. Color: White.
 - b. Finish: Matte
 - c. Corners: Square.
 - d. Width: As indicated on Drawings.

- e. Height: As indicated on Drawings.
 - f. Mounting: Wall.
 - g. Mounting Height: As indicated on Drawings.
 - h. Factory-Applied Aluminum Trim: Manufacturer's standard with clear anodic finish.
 - i. Color: As selected by Architect from full range of industry colors and color densities.
 - j. Accessories:
 - 1) Chalk tray: Box type.
2. Marker board: Tempered marker board assembly.
- a. Color: White.
 - b. Finish: Glass with magnetic backing
 - c. Corners: Square.
 - d. Width: As indicated on Drawings.
 - e. Height: As indicated on Drawings.
 - f. Mounting: Wall.
 - g. Mounting Height: As indicated on Drawings.
 - h. Field-Applied Aluminum Trim: Clear anodic finish.
 - i. Accessories:
 - 1) Storage Cabinet as indicated on drawings.
- B. Tackboard: Factory assembled.
- 1. Tack Surface: Plastic-impregnated-cork tackboard assembly.
 - a. Color: As selected by Architect from full range of industry colors.
 - 2. Corners: Square.
 - 3. Width: As indicated on Drawings.
 - 4. Height: As indicated on Drawings.
 - 5. Mounting: Wall.
 - 6. Mounting Height: As indicated on Drawings.
 - 7. Edges: Concealed by trim.

- a. Factory-Applied Aluminum Trim: Manufacturer's standard style, with clear anodic finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motor-operated, sliding visual display units.
- C. Examine walls and partitions for proper preparation and backing for visual display surfaces.
- D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.
- F. Projection Dry Erase Wallcovering:
 1. Examine substrates and installation conditions to ensure surface conditions meet or exceed a Level 4 finish, per GA-214-M-97: Recommended Levels of Gypsum Board Finish, and permanent lighting should be installed and operational.
 2. Test substrate with suitable moisture meter and verify that moisture content does not exceed four percent.
 3. Verify substrate surface is clean, dry, smooth, structurally sound, and free from surface defects and imperfections that would show through the finished surface.
 4. Evaluate all painted surfaces for the possibility of pigment bleed-through.
 5. Notify the contractor and architect in writing of any conditions detrimental to the proper and timely completion of the installation.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.

3.3 INSTALLATION, GENERAL

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Projection Dry Erase Wallcovering:
 - 1. Acclimate wallcovering in the area of installation a minimum of 24 hours before installation.
 - 2. Read and follow the manufacturer's installation instruction sheet contained in each roll of the dry erase wallcovering.
 - 3. Examine all materials for pattern, color, quantity and quality, as specified for the correct location prior to cutting.
 - 4. Primer: Use a quality pigmented acrylic wallcovering primer.
 - 5. Adhesive: Apply a uniform coat of heavy-duty pre-mixed clay-based or extra strength clear wallcovering adhesive.
 - 6. Install each strip horizontally and in the same sequence as cut from the roll.
 - 7. Install dry erase wallcovering sheets in exact order as they are cut from bolt. Reverse hang alternate strips (except lined products). Do not crease or bend the wallcovering when handling.
 - 8. Install dry erase wallcovering horizontally using a level line.
 - 9. Using a level or straight edge, double cut the seam with a seam-cutting tool (Ex: Double Seam-Cutter or Swedish Knife). Do not score drywall or plasterboard when cutting material.
 - 10. When covering the entire wall, seam the material out of the main writing and viewing areas of the wall.
 - 11. Apply wallcovering to the substrate using a wallcovering smoother, wrapped with a soft cloth, to remove air bubbles. Do not use sharp edged smoothing tools. Smooth material on the wall from the middle to the outside edge.
 - 12. Remove excess adhesive immediately after the wallcovering is applied. Clean entire surface with a warm mild soap solution, and clean soft cloths. Rinse thoroughly with water and let dry before using. Change water often to maintain water clarity.
 - 13. Stop installation of material that is questionable in appearance and notify the manufacturer's representative for an inspection.

3.4 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100

SECTION 101400 – INTERIOR SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Room-identification signs.

- B. Related Requirements:

- 1. Division 01 Section "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.
 - 2. Division 10 Section "Directories" for building directories.
 - 3. Division 14 Section "Electric Traction Elevators" for code-required conveying equipment signage.
 - 4. Division 22 Section "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
 - 5. Division 23 Section "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
 - 6. Division 26 Section "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
 - 7. Division 26 Section "Interior Lighting" for illuminated, self-luminous, and photoluminescent exit sign units.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 2. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content.
 3. Laboratory Test Reports for Credit EQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For panel signs.
1. Include fabrication and installation details and attachments to other work.
 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
 4. .
- D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
1. Include representative Samples of available typestyles and graphic symbols.
- E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
1. Panel Signs: Not less than 12 inches (300 mm) square, including corner.
 2. Room-Identification Signs: Full-size Sample.
- F. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For signs to include in maintenance manuals.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- 1.8 FIELD CONDITIONS
- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL SIGNS, GENERAL

- A. Regional Materials: Panel signs shall be manufactured within 500 miles (800 km) of Project site.

2.2 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
- B. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for signs.

2.3 SIGNS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturer in compliance with Montgomery College's signage standards:
 - 1. Systech Signage Technologies.
- B. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Basis-of-Design Product:
 - a. Models:
 - 1) The Architectural Modular Series and
 - 2) Modular Window Sign (paper insert) with Architectural Modular Series
 - b. Manufacturer: Systech Signage Technologies.
 - c. Design: See drawings.
 - d. Mounting: Manufacturer's standard method for substrates indicated with concealed anchors or adhesive.
 - e. Text and Typeface: Accessible raised characters and Braille typeface "Meta plus LF" and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
 - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
 - c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
 3. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.
- B. Adhesives: As recommended by sign manufacturer and with a VOC content of 70 g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 5. Internally brace signs for stability and for securing fasteners.
 6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.
1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
 2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.

3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
 4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.
- C. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- D. Subsurface-Engraved Graphics: Reverse engrave back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- E. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.
- F. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert. Furnish two blank inserts for each sign for Owner's use.
 2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Furnish two blank inserts for each sign for Owner's use.
 3. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. Subsequent changeable sign panels are by Owner.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, Class II, 0.010 mm or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.8 METALLIC-COATED STEEL FINISHES

- A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A 780/A 780M.
- B. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the organic coating to be applied over it.
- C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

2.9 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, and prepare for coating according to coating manufacturer's written instructions.
 - 1. For Baked-Enamel or Powder-Coat Finish: After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.
- B. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.
- C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

2.10 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 2. Directional Satin Finish: No. 4.
 - 3. Dull Satin Finish: No. 6.
 - 4. Reflective, Directional Polish: No. 7.
 - 5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- D. Verify that electrical service is correctly sized and located to accommodate signs.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 - 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated and according to accessibility standard.
- C. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 - 2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
 - 3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.

4. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
 5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
 6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
- D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101400

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes solid-polymer units as follows:
 - 1. Solid-polymer toilet compartments configured as toilet enclosures and urinal screens.
 - a. Toilet Enclosures: Floor-anchored, overhead braced enclosures.
 - b. Urinal Screens: Wall hung.
- B. Related Sections include the following:
 - 1. Division 06 Section "Miscellaneous Rough Carpentry" for blocking.
 - 2. Division 10 Section "Toilet Accessories" for toilet tissue dispensers, grab bars and similar accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
- D. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch-(150-mm-) square Samples of same thickness and material indicated for Work.

1.4 QUALITY ASSURANCE

- A. Comply with requirements in CID-A-A-60003, "Partitions, Toilets, Complete."

- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 SOLID-POLYMER UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Accurate Partitions Corporation.
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corporation; Mills Partitions.
 - 4. General Partitions Mfg. Corp.
 - 5. Scranton Products
- B. Toilet-Enclosure Style: Floor anchored, overhead braced.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
 - 2. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range.
- E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
- F. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; extruded aluminum or stainless steel.

2.2 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - 1. Material: Chrome-plated, nonferrous, cast zinc alloy (zamac) or clear anodized aluminum.
- B. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - 1. Material: Clear-anodized aluminum, stainless steel or chrome-plated brass.
 - 2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position.
 - 3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 - 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 - 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 - 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- C. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

- A. Floor-anchored, overhead-braced units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Doors: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).

- B. Floor-anchored, overhead-braced units: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Wall-Hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102219 - DEMOUNTABLE PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Non-progressive, moveable and reconfigurable system of unitized glass panels.
- 2. Products supplied but not installed under this Section: Voice/data cabling, devices, faceplates for thermostats and other devices.

- B. Related Sections:

- 1. Section 081416 "Flush Wood Doors" for doors installed in glass demountable partitions.
- 2. Section 087100 "Door Hardware" for hardware installed on doors.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 COORDINATION

- A. Coordination:

- 1. Coordinate installation of glass panel partitions with installation of floor, wall, and ceiling construction to comply with substrate tolerance requirements of partition manufacturer.
- 2. Coordinate installation of anchors and secondary structural members indicated on approved glass panel partition shop drawings and specified in other sections.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. LEED Submittals:

- 1. Product Data for Credit EQ 4.1: For installation adhesives, documentation including printed statement of VOC content.

- C. Shop Drawings: For demountable partitions.

1. Include plans, elevations, and sections; attachment details at floors, columns, permanent partitions, and ceilings; and method of erection and disassembly.
2. Include diagrams for power-, signal-, and control-wiring raceways; and details of access to raceways.

D. Samples for Verification: For each type of the following products:

1. Linear Trim: 12-inch- (300-mm-) long samples.
2. Door Finish: Manufacturer's standard-size unit, but not less than 3 inches (75 mm) square.
3. Glazing: Manufacturer's standard-size unit, but not less than 3 inches (75 mm) square.
4. Hardware and Accessories: Whole units.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from the installers of the items involved.

1. Suspended-ceiling components and dimensioned ceiling-grid layout.
2. Locations of fixed door and window mullions.
3. Seismic bracing and related structural members.
4. Ductwork above ceiling.

B. Product Certificates: For each type of demountable partition.

C. Product Test Reports: For each type of demountable-partition assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Qualification Data: For qualified installer.

E. Warranty: Sample of manufacturer warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For demountable partitions to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Partition Components: Furnish a quantity of each type of full-size unit with installation tools and materials equal to one percent of the amount installed, but no fewer than 2 units.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. All primary products specified in this Section shall be supplied by a single manufacturer with a minimum of ten (10) years' experience.
 2. Installer Qualifications: All products listed in this section shall be installed by a single installer with a minimum of two (2) years documented experience in installing products of the same type and scope as specified, and approved by the manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
1. Build mockups for demountable partitions including accessories.
 - a. Size: 48 inches (1200 mm) by 48 inches (1200 mm) or one module width by full height.
 - b. Each type of exposed construction, corner, and door and frame.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 WARRANTY

- A. Special Manufacturer's Warranty: Standard form in which manufacturer agrees to repair or replace components of glass panel partitions that demonstrate deterioration or faulty operation due to defects in materials or workmanship under normal use within warranty period specified.
1. Warranty Period: Ten (10) years from date of Substantial Completion.

1.11 DELIVERY STORAGE AND HANDLING

- A. Deliver demountable partition components cartoned or crated to provide protection during transit and job storage.
- B. Inspect demountable partition components upon delivery for damage. Minor damages may be repaired, provided finish items are equal to new work and acceptable to Architect. Remove and replace damaged items as directed.
- C. Store demountable partition components on raised platforms in vertical positions with blocking between units to allow air circulation. Keep stored material covered and protected from damage.

1.12 FIELD CONDITIONS

- A. Finished Spaces: Do not deliver or install demountable partitions until finishes in spaces to receive them are complete, including suspended ceilings, floors, carpeting, and painting.
- B. Field Measurements: Indicate measurements on Shop Drawings.
- C. Coordination of work: Coordinate layout and installation of the system components with other units of work. Installation of ceilings, floor coverings, lighting fixtures, HVAC equipment and fire suppression systems should be complete before the system components are installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

- B. Structural Performance: Provide demountable partitions capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Load-Bearing Capacity: Not less than 300-lb (136-kg) concentrated proof load when tested according to BIFMA X 5.6.
 - 2. Panels or panel framing members shall exhibit lateral deflection not greater than 1/240 of span when subjected to a uniformly distributed load of 5 psf.
 - 3. At a minimum, glass thickness shall conform to the requirements of ASTM E1300.
 - 4. Glass framing members shall be sized to limit glass edge deflection not greater than 1/175 or .75", whichever is less, when subjected to a uniformly distributed load of 5 psf.
 - 5. Glazing materials shall comply with the requirements of 16 CFR Part 1201 and/or ANSI Z97.1-2004, and shall bear markings as required by Chapter 24 of the International Building Code.

- C. Acoustical Performance: Where acoustical rating is indicated, provide demountable-partition assembly tested by a qualified testing agency for sound transmission loss performance according to ASTM E 90, calculated according to ASTM E 413, and rated for not less than the STC value indicated.

2.2 UNITIZED-PANEL DEMOUNTABLE PARTITIONS

- A. General: Unitized, nonprogressive, demountable-partition assembly and components that are the standard products of manufacturer.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Haworth, Inc.
 - b. Hugh Robinson, Inc.
 - c. INSCAPE Corporation.
 - d. KI.
 - e. Nello Wall Systems, Inc.
 - f. Steelcase Inc.
 - g. Transwall Office Systems, Inc.
 - h. Trendway Corporation.
 - 2. The system shall include a freestanding option that does not require a connection or attachment to the ceiling.
 - 3. Each unitized panel shall be able to be removed, relocated and re-installed in different layouts, with all parts reusable. Scribing and fitting of panels on site to individual locations is not acceptable.

4. The system shall provide a vertical adjustment of not less than 2" in overall height to accommodate floor and ceiling irregularities.
 5. The system must be erected and removed in a manner to prevent damage to adjacent building surfaces and elements, including floors, walls, ceilings, columns and window mullions. All system connectors to fixed-in-place building components shall be non-marking, removable and reusable.
 6. The system shall be capable of extending in multiple directions using 2-way, 3-way, 4-way and variable angle corner posts.
- B. Acoustical Rating: Minimum STC 35.
- C. Unitized Panels: Manufacturer's standard framed glass panels.
1. Thickness: Minimum 2-1/4 inches (57 mm).
 2. Panel Widths: Modular, as indicated on Drawings.
- D. Framing: Manufacturer's standard.
1. Exposed Finish: Clear-anodized aluminum.
- E. Trim: Continuous, factory-finished, snap-on type; adjustable for variations in floor level.
1. Trim Material: aluminum.
 2. Panel Joints: Manufacturer's standard.
 3. Base Profile: Flush.
 4. Exposed-Metal Trim Finish: Clear-anodized aluminum.
- F. Doors: 1-3/4-inch- (45-mm-) thick, as specified in Section 081416 "Wood Doors."
- G. Door Frames: Manufacturer's standard aluminum frames for 1-3/4-inch (45-mm) doors, factory mortised to receive hardware.
1. Frame Finish: Clear-anodized aluminum.
- H. Hardware: As specified in Section 087100 "Door Hardware".
- I. Glazing Frames: Manufacturer's standard aluminum frames for glazing thickness indicated.
1. Frame Finish: Clear-anodized aluminum.
- J. Glazing: Fully tempered clear float glass.
1. Thickness: 1/2 inch (12 mm).
- K. Seals: Manufacturer's standard.
- L. Electrical Devices: Integral, concealed raceways and wiring to serve electrical power and communication devices indicated on Drawings.
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency, and marked for intended location and application.

2.3 FABRICATION

- A. General: Fabricate demountable walls for installation with concealed fastening devices and pressure-fit members that will not damage ceiling or floor coverings. Fabricate systems for installation with continuous seals at floor, ceiling, and other locations where partitions abut fixed construction.
- B. Panels for Unitized-Panel Demountable Partitions: Factory-assembled, flush, unitized-panel construction; with faces smooth and free of buckles, oil canning, and seams; and insulated with solidly packed, inorganic, mineral filler.
 - 1. Factory glaze panels to the greatest extent possible.
- C. Wiring: Conceal conductors and cables in raceways. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

2.4 WOOD MATERIALS

- A. Certified Wood: Products fabricated with wood-based components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Particleboard: Panels complying with ANSI A208.1, Grade M-2.
 - 1. Made with binder containing no urea formaldehyde.
- C. Wood Veneer: Genuine wood veneer; clear, vertical grain, straight, and kiln dried; of wood species indicated, laminated to panel substrate with moisture-resistant adhesive.

2.5 OTHER MATERIALS

- A. Adhesives: As recommended by demountable-partition manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class II, 0.010 mm or thicker clear anodic coating over a nonspecular as fabricated mechanical finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install demountable partitions after other finishing operations have been completed.
 - 1. Install partitions rigid, level, plumb, and aligned. Install seals at connections with floors, ceilings, fixed walls, and abutting surfaces to prevent light and sound transmission.
 - 2. Broken, cracked, chipped, deformed, or unmatched panels and components are not acceptable.
 - 3. Except for filler panels scribed to fixed walls or columns, do not modify manufacturer's standard components.
- B. Doors and Frames: Install door-and-frame and glazing-and-glazing-frame assemblies securely anchored to partitions and with doors aligned and fitted. Install and adjust door hardware for proper operation.

3.2 ERECTION TOLERANCES

- A. Install each demountable partition so surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent partitions.

3.3 ADJUSTING

- A. Inspect installation, correct misalignments, and tighten loose connections.
- B. Adjust doors to operate smoothly and easily, without binding or warping.
- C. Check and readjust operating hardware. Verify that latches and locks engage accurately and securely without forcing or binding; lubricate as recommended by manufacturer.
- D. Clean soiled surfaces to remove dirt, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.
- E. Remove and replace defaced or damaged components that cannot be satisfactorily repaired.
- F. Remove and replace components that are wet, moisture damaged, or mold damaged.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain demountable partitions.

END OF SECTION 102219

SECTION 102600 – WALL AND DOOR PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Provide wall corner and door protection systems.
- B. High Impact Wall Covering

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

1.3 LEED Submittals:

- A. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
- B. Product Data for Credit MR 4.1 and 4.2: For products having recycled content, documentation indicating percentages by weight of post consumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
- C. Product Data for Credit MR 5.1 and 5.2: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.4 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Performance: Fire performance meeting code requirements.
- C. Fire performance characteristics: Provide engineered PETG wall protection system components with UL label indicating that they are identical to those tested in accordance with ASTM E84 for Class 1 characteristics listed below:
 - 1. Flame spread: 25 or less
 - 2. Smoke developed: 450 or less

PART 2 PRODUCTS

2.1 MATERIALS

- A. Corner Guards (**CG-1**):
 - 1. Basis of Design: Stainless steel corner guards to be by Construction Specialties:
 - a. Acrovyn Model CO-8, 90 degree 16 gauge stainless steel corner guard with 3-1/2" (88.9) standard legs.
 - b. Surface mounted with construction adhesive standard.

- B. High Impact Wall Covering (**WC-1**):
 - 1. Basis of Design: C/S Acrovyn:
 - a. Acrovyn Model 4000.040N Rigid Sheet with Inside Corner Trim, Standard (Suede) Texture, Color 136 Pearl Grey
 - b. Size: See drawings. Field Verify with installed mop sink and service faucet.

- C. Door Protection Systems:
 - 1. Type: Door surface protection, kick/armor plates.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

- B. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION 102600

SECTION 102800 – TOILET ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Provide toilet accessories.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. In compliance with Montgomery College standards, the manufacturer shall be Bobrick for the following accessories:
 - 1. Grab bars.
 - i. Model: As indicated on Drawings
 - 2. Toilet tissue dispensers, double roll.
 - i. Model: As indicated on Drawings
 - 3. Sanitary napkin disposal units
 - i. Model: As indicated on Drawings
 - 4. Seat cover dispensers.
 - i. Model: As indicated on Drawings.
- B. In compliance with Montgomery College standards, the manufacturer shall be Betco for the following accessory:
 - 1. Soap dispensers, wall mounted.
 - i. Model: As indicated on Drawings.
- C. In compliance with Montgomery College standards, the manufacturer shall be San Jamar for the following accessory:
 - 1. Paper towel dispensers
 - i. As indicated on Drawings.

- D. Manufacturers and products for the following accessory may include any of the following:
1. Mop and broom holders.
 - i. American Specialties, Inc
 - ii. Bradley Corp
 - iii. Clarion Bathware
 - iv. Hafele America Co
 2. Undercounter lavatory pipe guards.
 - i. Truebro Lav Guard2
 - ii. Plumberex Specialty Products, Inc., ProExtreme
 - iii. TCI Products Skal Guard
- E. Mirrors and Frames:
1. Glazing: Mirror glass, 1/4 inch thick, ASTM C 1036.
 2. Frames: Stainless steel.
 3. Type: Standard wall unit.
 4. Finish: Stainless steel; AISI Type 302 or 304, No. 4 polished finish.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

END OF SECTION

SECTION 105123 - PLASTIC-LAMINATE-CLAD LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes plastic-laminate-clad wood lockers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of plastic-laminate-clad wood locker.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
 - 3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured and regionally extracted and manufactured materials. Include statement indicating cost for each regionally manufactured material.
 - a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
 - b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
 - 4. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
 - 5. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

6. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.
7. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For plastic-laminate-clad wood lockers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Show details full size.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in lockers.
5. Show locker fillers, trim, base and accessories.
6. Show locker numbering sequence.

D. Samples for Initial Selection: For the following:

1. Factory-applied finishes.
2. High-pressure decorative laminates.

E. Samples for Verification: For the following products:

1. Plastic-laminate-clad panels, not less than 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish.
2. Corner pieces of locker front frame joints between stiles and rail, as well as exposed end pieces, not less than 18 inches wide by 18 inches high by 6 inches deep (457 mm wide by 450 mm high by 152 mm deep).
3. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support lockers by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where lockers are indicated to fit to other construction, establish dimensions for areas where lockers are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate sizes and locations of concealed wood support bases.
 - 1. Requirements are specified in Section 061000 "Rough Carpentry."
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of locks or hardware.
 - c. Deterioration of wood and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD WOOD LOCKERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Classic Woodworking, LLC.
 2. Club Resource Group.
 3. Famous Lockers.
 4. Hollman, Inc.
 5. Ideal Products, Inc.
 6. Legacy Lockers.
 7. List Industries Inc.
 8. Treeforms.
- B. Forest Certification: Fabricate lockers with wood-based panel products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- C. Regional Materials: Lockers shall be manufactured within 500 miles (800 km) of Project site.
- D. Construction Style: As indicated.
- E. Locker Body: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay.
1. Side Panels: Manufacturer's standard 3/4 or 5/8 inch (19 or 16 mm) thick.
 2. Back Panel: Manufacturer's standard 1/2 or 3/8 inch (13 or 9.5 mm) thick.
 3. Top Panel: Manufacturer's standard 3/4 or 5/8 inch (19 or 16 mm) thick.
 4. Bottom Panel: Manufacturer's standard 3/4 or 5/8 inch (19 or 16 mm) thick.
 5. Exposed Panel Edges: Thermoset decorative overlay to match .
- F. Plastic-Laminate-Clad Wood Doors: High-pressure decorative laminate, Grade VGS, over both sides of medium-density-fiberboard core.
1. Thickness: Manufacturer's standard 3/4 or 5/8 inch (19 or 16 mm) thick.
 2. Panel Edges: High-pressure decorative laminate, Grade VGS, to match panels.
- G. End Panels: Match style, material, construction, and finish of plastic-laminate-clad wood doors.
- H. Shelves: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay; fixed unless otherwise indicated.
1. Thickness: 3/4 inch (19 mm).
 2. Exposed Edges: High-pressure decorative laminate, Grade VGS, to match panels.
- I. Corners and Filler Panels: 3/4-inch- (19-mm-) thick panels. Match style, material, construction, and finish of plastic-laminate-clad wood doors.
- J. Continuous Finish Base: Plastic-laminate-clad, 3/4-inch- (19-mm-) thick panel that matches door faces; fabricated in lengths as long as practical to enclose base and base ends of lockers.

- K. Plastic-Laminate Colors, Patterns, and Finishes:
1. Match Architect's samples.

2.2 MATERIALS

- A. Composite Wood: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
 2. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
 3. Softwood Plywood: DOC PS 1, medium-density overlay.
 4. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
- B. High-Pressure Decorative Laminate: NEMA LD 3, grades as follows:
1. Horizontal Surfaces: Grade HGS.
 2. Postformed Surfaces: Grade HGP.
 3. Vertical Surfaces: Grade VGS.
- C. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- D. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- E. Wood Support Base: 2-by-4-inch nominal-size (51-by-102-mm, actual-size) lumber treated with manufacturer's standard preservative-treatment, nonpressure process.

2.3 HARDWARE

- A. Cam Padlock Hasp: Surface mounted, steel; finished to match other locker hardware.
- B. Frameless Hinges (European Type): Fully concealed, nickel-plated steel, with not less than 125 degrees of opening.
1. Provide two hinges for doors 36 inches (910 mm) high and less.
 2. Provide three hinges for doors more than 36 inches (910 mm) high.
- C. Wire Pulls: Back mounted; 4 inches (102 mm) long, 5/16 inch (8 mm) in diameter.
- D. Shelf Rests: BHMA A156.9, B04013.
- E. Hooks: Manufacturer's standard, ball-pointed aluminum or steel; finished to match other locker hardware. Attach hooks with at least two fasteners.
1. Provide two single-prong wall hooks for each compartment.
- F. Exposed Hardware Finishes: Satin chrome unless otherwise indicated.

2.4 ACCESSORIES

- A. Number Plates: 1-1/2-inch- (38-mm-) diameter, etched, embossed, or stamped, stainless-steel plates with black numbers and letters at least 1/2 inch (13 mm) high.

2.5 FABRICATION

- A. Fabricate each locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.
 - 1. Fabricate lockers to dimensions, profiles, and details indicated.
 - 2. Ease edges of corners of solid-wood members to 1/16-inch (1.5-mm) radius.
- B. Fabricate components square, rigid, without warp, and with finished faces flat and free of scratches and chips. Accurately factory machine components for attachments. Make joints tight and true.
 - 1. Fabricate lockers using manufacturer's standard construction, with joints made with dowels, dados, or rabbets. Dado side panels to receive shelving except where indicated to be adjustable.
 - 2. Fabricate lockers with joints that are dadoed or rabbeted, glued full length, and stapled. Dado side panels to receive shelving except where indicated to be adjustable.
- C. Accessible Lockers: Fabricate as follows:
 - 1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.
 - 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.
- D. Number Plates: Inlay number plates flush in each locker door, near top, centered.
- E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- F. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Condition lockers to average prevailing humidity conditions in installation areas before installation.
- B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

- A. Install wood support base with 1/2-inch- (13-mm-) thick plywood top.
- B. Install lockers level, plumb and true; use concealed shims.
- C. Connect groups of lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.
- D. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Installation Tolerance: No more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line. Shim as required with concealed shims.
- E. Locker Anchorage: Fasten wood lockers through back, near top and bottom, at ends with No. 8 flush-head wood screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or furring and spaced not more than 16 inches (400 mm) o.c.
- F. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.
- G. Install number plates after lockers are in place.
 - 1. Attach number plate on each locker door, near top, centered, with at least two screws with finish matching number plate.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding.
- B. Protect lockers from damage, abuse, dust, dirt, stain or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105123

SECTION 105200 – FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
- B. Section includes fire protection cabinets and portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets, fire extinguisher and mounting brackets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For each type of fire protection cabinet indicated.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Size: 6 by 6 inches (150 by 150 mm) square.
- E. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.
- F. Maintenance Data: For fire protection cabinets to include in maintenance manuals.
- G. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.
- H. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.5 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.
- C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.
- D. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHER CABINETS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: ASTM B 209 (ASTM B 209M).
 - 2. Extruded Shapes: ASTM B 221 (ASTM B 221M).
- C. Stainless-Steel Sheet: ASTM A 666, Type 304.
- D. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire End & Croker Corporation;.
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group;.
 - c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc; Insert product name or designation.
 - d. Larsen's Manufacturing Company; Insert product name or designation.
- B. Cabinet Construction: Nonrated.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Stainless-steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
 - 2. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Acrylic sheet.
 - 1. Acrylic Sheet Color: Clear transparent acrylic sheet.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide manufacturer's standard.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
 - 1. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 - 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

- a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Decals.
 - 3) Lettering Color: Black.
 - 4) Orientation: Vertical.

- K. Finishes:
1. Stainless Steel: No. 4.

2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
1. Run grain of directional finishes with long dimension of each piece.

2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

2.6 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - h. Larsen's Manufacturing Company.
 - i. Moon-American.
 - j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
 - k. Potter Roemer LLC.
 - l. Pyro-Chem; Tyco Safety Products.
 2. Valves: Manufacturer's standard.
 3. Handles and Levers: Manufacturer's standard.
 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- B. Regular Dry-Chemical Type in Steel Container: UL-rated 10-B:C, 5-lb (2.3-kg) nominal capacity, with sodium bicarbonate-based dry chemical in enameled-steel container.
- C. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 2-A:10-B:C, 5-lb (2.3-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
- D. Carbon Dioxide Type: UL-rated 5-B:C, 5-lb (2.3-kg) nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal container.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Examine fire extinguishers for proper charging and tagging.
1. Remove and replace damaged, defective, or undercharged fire extinguishers.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 - 1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
- C. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- D. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 105200

SECTION 115213

PROJECTION SCREENS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Montgomery College Audiovisual (AV) Standards shall be referenced as a general design guideline for this project.

1.2 SUMMARY

- A. Section Includes:
 - 1. Type A: Ceiling hung, permanently tensioned, electric operation projection screens with 133" diagonal viewing area (16:9 aspect ratio image size).
 - 2. Type B: Wall mounted, permanently tensioned, electric operation projection screens with 133" diagonal viewing area (16:9 aspect ratio image size).
 - 3. All electronic screens shall be equipped with 24 volt wall mounted remote three-position control switch (Draper LVC-S or approved comparable product) with cover and plate located adjacent to the projection screen, along with low voltage interface (Draper LVC-III or approved comparable product) or approved comparable product) to audiovisual remote control systems.
 - 4. Coordination with published Montgomery College AV Standards is required..

1.3 RELATED SECTIONS

- A. Division 5 Section Metal Fabrications for support and hanging systems.
- B. Sections of Division 26 for electrical wiring, connections, and installation of control switches for electrically operated equipment.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions for each piece of equipment.
- B. Shop Drawings: Submit shop drawings for each type of equipment.

1.5 QUALITY ASSURANCE

- A. Obtain each type of equipment required from a single manufacturer as complete units, including necessary hardware and accessories.
- B. Measure gain of screen viewing surface against that of a magnesium carbonate surface by means of a photogoniometer using testing methods and test apparatus per FS GG-S-00172D (I) for determining the effect of reflected light at various viewing angles on screen surfaces.
- C. Provide screen fabrics identical to those materials which have undergone testing and passed requirements for flame resistance as outlined in NFPA 701 per small sample test.

- D. Provide a seamless mildew resistant screen fabric as determined by Federal Standard 191 A/5760.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with the manufacturers requirements for temperature and humidity conditions.

PART 2 PRODUCTS

2.1 AVAILABLE MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work to include, but are not limited to, the following:
 - 1. Electric projection screens:
 - a. Tensioned Advantage Deluxe Electrol; Dalite; Warsaw, IN; 800-622-3737
 - b. Access V; Draper; Spiceland IN; 800-238-7999.
 - c. Model A & B; Stewart Filmscreen; Torrance CA; 800 762 4999.
 - 2. Projection screen locations shall be in areas as indicated on "TA" Series drawings:
 - a. Type A: 133-inch (diagonal measure), 16:9 aspect ratio.

2.2 MATERIALS AND FABRICATION

- A. Provide each electrically operated, ceiling recessed front projection screens manufactured as an integral unit consisting of roller, screen fabric, finished retracting "trap-door" assembly, mounting accessories and all other components for a complete installation and complying with all requirements.
- B. The unit shall be UL-listed and bear UL re-examination markers.
- C. Screen limitation drop, or permanent mounting position, will position the bottom of the displayed image as listed below. Verify drop distance with ceiling height information prior to ordering equipment.
 - 1. Type A: 48-inches above finish floor.
- D. Provide extra drop at top of screens, as follows:
 - 1. Type A: 12 inches.
- E. Fabric: The image area shall be a completely seamless, vinyl-coated glass-fiber, white fabric with a gain of 1.0 to 1.3 and a gain of not less than 0.8 at an angle of 50 degrees from the axis of the screen surface. It shall have a black masking border and be cable-tensioned. It shall have a mildew resistance rating of 0 or 1 when tested according to ASTM G21. It shall have flame resistance passing NFPA 701.
- F. Case: Aluminum or steel, and fire-retardant hardboard, with removable access panels on the bottom or side of the case. The unit shall have an integral motorized trap door. The case shall be finished to match ceiling on the bottom.

- G. Motor: Size and capacity as recommended by the manufacturer for the screen. Provide an instant reversing in roller motor with vibration isolators and permanently lubricated ball bearings. It shall have automatic thermal overload protection and preset limit switches to automatically stop the screen in the fully "UP" or "DOWN" position. The stop action shall be positive to prevent coasting. The motor shall be acoustically isolated to limit operating noise.
- H. Control: Provide low voltage (24 volts or less) controls wired to a three position switch located on the screen wall near the teaching station. The wall plate shall have push button control for "UP", "DOWN", and "STOP". .

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install equipment at locations indicated in compliance with the manufacturers instructions, including, but not limited to, Installation Instructions.
- B. Install in position and relationship to adjoining work indicated, securely anchored to supporting substrate, sealed and finished, and in a manner, which produces a smooth screen with square, plumb, and straight edges.
- C. Install with proper clearance between the gypsum board, the ceiling tiles, the screen, and the jam. Electric screens are to be installed with housing (case) concealed just above room ceiling tiles. Provide cutout opening with finish in drop tile or hard ceiling for screen drop.
- D. The equipment shall be inspected upon arrival to the job site. The equipment shall be stored in their original crates until installation.

3.2 ADJUST AND CLEAN

- A. Protect equipment after installation from damage during construction including, but not limited to, paint, scratches, and dirt. If, despite such protection, damage occurs, remove and replace damaged components or entire unit as required to restore units to their original, undamaged condition.
- B. Adjust assembly after installation for proper operation and screen drop/ retract.

END OF SECTION

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes roller shades and motorized shade operators.
- B. Related Sections include the following:
 - 1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
 - 2. Division 26 Sections for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
 - 1. Motorized Shade Operators: Include operating instructions.
 - 2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.
 - 1. Motorized Shade Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - 2. Wiring Diagrams: Power, system, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension system members and attachment to building structure.
 - 2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades and special moldings at walls, column penetrations and other junctures of acoustical ceilings with adjoining construction.
 - 3. Shade mounting assembly and attachment.
 - 4. Size and location of access to shade operator, motor and adjustable components.
 - 5. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

- D. Samples for Verification:
 - 1. Complete, full-size operating unit not less than 16 inches (400 mm) wide for each type of roller shade indicated.
 - 2. For the following products:
 - a. Shade Material: Not less than 12-inch- (300-mm-) square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.
- E. Product Certificates: For each type of roller shade, signed by product manufacturer.
- F. Qualification Data: For Installer.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency, for each type of roller shade.
- H. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining roller shades and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
 - 3. Operating hardware.
 - 4. Motorized shade operator.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Source Limitations: Obtain roller shades through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Flame-Resistance Ratings: Passes NFPA 701.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Product Standard: Provide roller shades complying with WCMA A 100.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 ROLLER SHADES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide MechoShade; ElectroShade or a comparable product by one of but not limited to the following manufacturers:
 - 1. Lutron Shading Solutions by VIMCO.
 - 2. BTX Window Automation, Inc.
 - 3. Draper Inc.
- B. Shade Band Material: PVC-coated polyester.
 - 1. Fabric Width: As indicated on Drawings.
 - 2. Style:
 - a. Types: ThermoVeil 01300 Dense Basket Weave ShadeCloth
 - 1) Material Openness Factor: 10 - 12% percent.
 - 2) Color: 2113 - Grey
 - 3. Bottom Hem: As indicated by manufacturer's designation.
- C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material. Provide capacity for one roller shade band(s) per roller, unless otherwise indicated on Drawings.
- D. Direction of Roll: Regular, from back of roller and Regular, from back of roller, and reverse, from front of roller, as indicated on Drawings for double-roller shades.
- E. Mounting Brackets: Galvanized or zinc-plated steel.
- F. Pocket with Ceiling Slot Opening: Six-sided box units for recessed installation; fabricated from formed-steel sheet, extruded aluminum, or wood; with a bottom consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing rollers, brackets, and operating hardware and operators within; capacity for one roller shade two roller shades overlapping in queued pattern, front and back per pocket, unless otherwise indicated on Drawings.

- G. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; removable design for access.
- H. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.
- I. Bottom Bar: Steel or extruded aluminum. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.
- J. Mounting: Recessed in ceiling pocket mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.
- K. Shade Operation: Motorized operator.

2.2 ROLLER SHADE FABRICATION

- A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.
- B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 - 1. Lifting Mechanism: With permanently lubricated moving parts.
- C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 - 1. Shade Units Installed between (Inside) Jamb: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
 - 2. Shade Units Installed Outside Jamb: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting recessed ceiling pocket, roller, and operating hardware and for hardware position and shade mounting method indicated.
- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
- F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
- G. Colors of Metal and Plastic Components Exposed to View: Matching or coordinating with shade band color as selected by Architect from manufacturer's full range, unless otherwise indicated.

2.3 MOTORIZED ROLLER SHADE OPERATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide MechoShade; ElectroShade or a comparable product by one of the following:
1. Elero USA Inc.
 2. SIMU US, Inc.
 3. SOMFY Systems.
- B. General: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.
- C. Comply with NFPA 70.
- D. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- E. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.
1. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 2. Motor Characteristics: Single phase, 95-120V, 60 Hz.(207-253)
 3. Motor Mounting: Within manufacturer's standard roller enclosure.
- F. Position of Motor and Electrical Connection: Install motor in locations as indicated in Drawings.
- G. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for surface mounting. Provide the following devices for remote-control activation of shades:
1. Control Stations: Keyed, momentary contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
- H. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.
- I. Operating Function: Stop and hold shade at five predetermined positions including open, closed, and three user-programmed positions.
- J. Operating Features: Include the following:
1. Group switching with integrated switch control; single face plate for multiple switch cut-outs.
 2. Capable of interface with audiovisual control system.
 3. Capable of accepting input from building automation control system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.
- B. Connections: Connect motorized operators to building electrical system.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller shades. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 122413

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Entrance mat system.
- B. Related Requirements:
 - 1. Section 033000 "Cast-In-Place Concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.
- B. Shop Drawings:
 - 1. Items penetrating floor mats and frames, including door control devices.
 - 2. Divisions between mat sections.
 - 3. Perimeter floor moldings.
 - 4. Custom Graphics: Scale drawing indicating colors.
- C. Samples: For the following products, in manufacturer's standard sizes:
 - 1. Floor Mat: Assembled sections of floor mat.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

- A. Structural Performance: Provide roll-up rail mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform floor load of 300 lbf/sq. ft. (14.36 kN/sq. m).
 - 2. Wheel load of 350 lb (159 kg) per wheel.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.2 ENTRANCE FLOOR MATS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide "Soft Grid™" as manufactured by Mats Inc. or a comparable product by one of the following:
 - 1. American Floor Products Company, Inc.
 - 2. Balco, Inc.
 - 3. C/S Group.
 - 4. Durable Corporation.
 - 5. J. L. Industries, Inc.
 - 6. Pawling Corporation; Architectural Products Division.
- B. Entrance Floor Mats: Open construction, vinyl drop-through panel foot grille; 100% pre-consumer recycled content.
 - 1. Colors, Textures, and Patterns of Inserts: As selected by Architect from full range of industry colors.
 - 2. Roll Thickness: 3/8".
 - 3. Mat Size: As indicated.
 - 4. Installation: Surface mounted.
- C. Framing and Nosing Accessories for Vinyl Foot Grille
 - 1. Surface Mounted Application: 3/8" inches grid and beveled, heavy-duty attached nosing.

2.3 FABRICATION

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.
 - 1. For installation in terrazzo flooring areas, provide allowance for grinding and polishing of terrazzo without grinding surface of recessed frames. Coordinate with other trades as required.
 - 2. Accessories: Where indicated for surface mount installations, provide tapered vinyl grid edge moldings with flanges cold-welded to back of mat.
 - 3. Install necessary shims, spacers, and anchorages for proper location, and secure attachment of frames.
 - 4. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.
- B. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.
 - 1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.
 - 2. Coordinate installation with adjacent work to ensure proper clearances and to prevent tripping hazards.

3.3 PROTECTION

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

SECTION 126200 - FIXED SEMINAR TABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes fixed seminar tables with the following:
 - 1. Radiused (curved) and straight fixed seminar tables.
 - 2. Modesty and end panels.
 - 3. Standard pedestal base floor mounting.
 - 4. Power and data service to individual seats.
- B. Related Sections:
 - 1. Division 26 Sections for electrical service and connections to fixed table junction box locations for power receptacles.
 - 2. Division 27 Sections for voice and data communication service and connections to fixed table junction box locations for data ports.

1.3 QUALITY ASSURANCE

- A. Fixed seminar tables shall be designed and manufactured in compliance with ANSI/BIFMA X5.4-1997 and shall meet or exceed all applicable BIFMA performance test criteria.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fixed seminar tables. Include electrical characteristics.
- B. LEED Submittals:
 - 1. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood and wood-based materials comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
 - a. Include statement indicating costs for each certified wood product.
 - 2. Product Data for Credit EQ 4.4: For each composite wood product, documentation indicating that product contains no urea formaldehyde.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Table Layout: Show table layout, aisle widths, table widths, and spacing in each row.
 2. Accessories: Show accessories, including locations of electrical devices, accessibility provisions, and attachments to other work.
 3. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Plastic Laminate: Manufacturer's standard-size unit, not less than 3 inches (75 mm) square.
 2. Baked-on Coating Finishes: Manufacturer's standard-size unit, not less than 3 inches (75 mm) square.
 3. Power and Data Service Devices: Full-size units.
 4. Exposed Fasteners: Full-size units of each type.
- E. Field quality-control reports.
- F. Maintenance Data: For fixed seminar tables to include in maintenance manuals. Include the following:
1. Precautions for cleaning materials and methods that could be detrimental to seating finishes and performance.
- G. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of table required, including accessories and mounting components, from single source from single manufacturer.
- B. Forest Certification: Fabricate products with wood components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockups for the following types of fixed seminar tables including finishes, and accessories:
 - a. Size: Minimum two-seat table.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install fixed tables until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary or permanent HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of table layout and construction contiguous with tables by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate layout and installation of electrical wiring and devices with table layout to ensure that floor junction boxes for electrical devices are accurately located to allow connection without exposed conduit.
 - 1. Coordinate wiring and power receptacles installed in seating with requirements in Division 26 Sections.
 - 2. Coordinate wiring and data ports installed in seating with requirements in Division 27 Sections.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fixed seminar tables that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including standards, beams, and pedestals.
 - b. Faulty operation of electrical components.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Periods: As follows, from date of Substantial Completion.
 - a. Structural: Lifetime.
 - b. Electrical Components: Three years.
 - c. Plastic, Wood, and Paint Components: Three years.

1.9 EXTRA MATERIALS

- A. Furnish extra materials from the same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Power Receptacles: Furnish a quantity of full-size units equal to 5 percent of amount installed.
 - 2. Data Ports: Furnish a quantity of full-size units equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS AND FINISHES

- A. Steel: ASTM A 36/A 36M plates, shapes, and bars; ASTM A 513 mechanical tubing; ASTM A 1008/A 1008M cold-rolled sheet; and ASTM A 1011 hot-rolled sheet and strip.
- B. Metal Finish: Finish exposed metal parts with manufacturer's standard baked-on, minimum 1.5-mil- (0.04-mm-) thick, baked-on powder coating.
 - 1. Color: As selected by Architect from manufacturer's full range.
- C. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
- D. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
- E. Plastic Laminate: NEMA LD 3, Grade VGS for vertical surfaces and Grade HGS for horizontal surfaces.
 - 1. Color and Pattern: As selected by Architect from manufacturer's full range.

2.2 FIXED SEMINAR TABLES

- A. Fixed Seminar tables: Interior fixed tables in permanent arrangement as shown on Drawings.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Irwin Seating Company, Inc. "Fixed Seminar Tables" or comparable product by one of the following:
 - a. Clarin.
 - b. KI, Inc.
- B. Table Mounting Pedestal: Manufacturer's standard cantilever-type, floor-mounted pedestal, rectangular-fabricated steel column.
 - 1. Pedestal Size: Manufacturer's standard height for 29 inch (737 mm) overall table height including tabletop thickness; 11-ga., 2 inch (51 mm) by 4 inch (102 mm) tubular steel.
 - 2. Manufacturer's standard stamped-steel floor flange and support arm.
 - 3. Pedestal bases to have cutout on backside of base to allow access to power and data cables. Cutout to have metal cover to match base.
 - 4. Provide manufacturer's standard escutcheon plate.
 - 5. Finish and color: Manufacturer's standard powder coat finish; Ccolor: #39 Neutral Grey.
- C. Table Tops:
 - 1. Thickness: 1 1/4" inch (31.75 mm) thick.
 - 2. Material: Top surface shall be 0.040 inch thick high pressure plastic laminate and bottom surface shall be 0.040 inch thick phenolic backer. Laminate and backer shall be permanently bonded to manufacturer's standard substrate.
 - a. Color: Nevamar "Aluminite", AM 6 IT.

3. Table Edge: Manufacturer's standard solid wood square edge; Maple to match Architect's sample.
 4. Table Top Depth: 24 inches (610 mm) typical unless indicated otherwise.
 - a. Modern Language Lab: 30 inches (762 mm) deep.
 - b. 90-Person Tiered Classrooms: 21 inches (533.4 mm) deep.
- D. Modesty and End Panels: Manufacturer's standard panels to match tabletop.
1. Manufacturer's standard T-mould edge at panel edges; Color: #39 Neutral Grey.
 2. Minimum 1 1/2 inch (38 mm) radius at panel corners.
 3. Panel Height: 14 inches (356 mm) unless indicated otherwise.
 4. Provide curved panels as required at curved table tops.
 5. Provide continuous modesty panels to greatest extent possible allowed by panel construction.
 6. Finish and Color: Nevamar "Clear Maple."
- E. Electrical Components:
1. Provide manufacturer's standard polycarbonate power/data box mounted in table top.
 2. Two electrical 15A/125V receptacles and two locations for data connectors per module; One module per two seats unless indicated otherwise; data port terminals with wiring and receptacles as specified in Divisions 26 and 27.
 3. Spring-loaded mechanism to allow unit to open for use and shall be able to close when not in use. Power receptacles shall open above the plane of the worksurface. Data jacks to remain stationary.
 4. Provide manufacturer's standard 22 inch (559 mm) cord with 3-prong plug to plug into 8-wire harness.
 5. Provide manufacturer's standard 8-wire harness with flexible conduit to distribute power between power/data modules and power infeed. Harness to be enclosed in rigid PVC, 0.06 inch (1.5 mm) trough with metal divider to separate power and data cables.

2.3 ACCESSORIES

- A. Provide additional accessories and fasteners as required and recommended by manufacturer for complete fixed seminar table installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine floors, risers, and other adjacent work and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixed seminar tables in locations indicated and fastened securely to substrates according to manufacturer's written installation instructions.
- B. Install tables in curved rows at a smooth radius as indicated.
- C. Install wiring conductors and cables concealed in components of tables and accessible for servicing.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Tests for Power Receptacles: As specified in Division 26 Sections.
 - 3. Tests for Data Ports: As specified in Division 27 Sections.
- B. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Verify that all components and devices are installed and operating properly.
- B. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.

END OF SECTION 126200

SECTION 129300 – SITE FURNITURE

PART I – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Work Includes:
 - 1. Concrete benches without backs
 - 2. Litter receptacles
 - 3. Recycling receptacles
 - 4. Tables with attached chairs
 - 5. Bike racks
 - 6. Picnic tables
 - 7. Benches

1.3 RELATED WORK

- A. Concrete for footings if indicated. See details.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete benches:
 - Color: B-3 Weatherstone Sand
 - Manufacturer: Wausau Tile
 - Size: 5' long x 2' wide
 - Model No: Cast concrete tapered bench with reveal, submit shop drawings.
 - Quantity: 15
 - Note: Total quantity includes 10 End Units and 5 Mid Units. See detail on plans.

- B. Litter receptacles:
 - Color: Silver
 - Manufacturer: Landscape Forms, Inc.
 - Size: 30 gal., wire grid, 20" diameter- litter receptacle is side opening.
 - Model No: Plexus, surface mounted.
 - Quantity: 11

- C. Recycling Receptacles:
Color: Ocean
Manufacturer: Landscape Forms, Inc.
Size: 30 gal. wire grid, 20" diameter- top opening with identifiable plaque.
Model: Plexus, surface mounted.
Quantity: 11
- D. Tables w/attached chairs:
Color: Silver
Manufacturer: Landscape Forms, Inc.
Size: 85-1/4" out to out, backed, wire grid seats w/perforated table top
Model No: Carousel, surface mounted
Quantity: 4 units w/4 seats and 1 w/3 seats, 5 total
- E. Bike Racks:
Color: Stainless steel – with electro-polish finish
Manufacturer: Landscape Forms, Inc.
Size: 27-1/4" diameter
Model: Ring - Surface mount
Quantity: 5
- F. Picnic Tables :
Color: Silver
Manufacturer: Landscape Forms, Inc.
Size: 72" x 30" x 32"
Model: Manistee, Surface mounted, metal grid seats w/perf. top
Quantity: 2
- G. Benches:
Powdercoat Color: Silver
Manufacturer: Landscape Forms, Inc.
Style: Straight Backed
Model: Plexus II
Number of Seats: 3 Seat Unit
Mounting: Surface Mounted
Quantity: 9

2.2 SHOP DRAWINGS

- A. Submit shop drawings for all items.
B. Provide color and finish samples for concrete benches.

- C. Provide recessed lights where indicated.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All items are surface mounted on concrete.
- B. Size of bolt will depend on the product specified. Refer to manufacturer's assembly instructions.
- C. Concrete benches are doweled to concrete pavement.
 - 1. Caulk all joints.
 - 2. Fill dowels with expansion cement.

3.2 CLEANING

- A. Remove any splashed concrete and dirt from metal surfaces. Touch up paint on exposed surfaces.

3.3 PROTECTION

- A. Protect all items from damage after installation.
- B. Wrap with protective material to prevent chipping.

END OF SECTION 129300

SECTION 142400 - ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes electric traction passenger elevators.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 2. Division 04 Section "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
 - 3. Division 05 Section "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Machine beams.
 - c. Weld plates for anchoring elevator machine to machine room floor slab.
 - d. Divider beams.
 - e. Hoist beams.
 - f. Structural-steel shapes for subsills and rail attachments.
 - g. Pit ladders.
 - 4. Division 26 Sections for electrical service for elevators to and including disconnect switches at machine room door and standby power source, transfer switch, and connection from auxiliary contacts in transfer switch to controller.
 - 5. Division 27 communications sections for telephone service for elevators.
 - 6. Division 28 Section "Fire Detection and Alarm" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

1.3 DEFINITIONS

- A. Definitions in ASME A17.1 apply to work of this Section.
- B. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
- C. Service Elevator: A passenger elevator that is also used to carry freight.

1.4 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
 - 1. Car enclosures and hoistway entrances.
 - 2. Operation, control, and signal systems.

- B. Shop Drawings:
 - 1. Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals.
 - 2. Include large-scale layout of car control station and standby power operation control panel.
 - 3. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
 - 4. Car, guide rails, buffers and other components in hoistway.
 - 5. Maximum rail bracket spacing.
 - 6. Maximum loads imposed on guide rails requiring load transfer to building structure.
 - 7. Clearances and travel of car.
 - 8. Clear inside hoistway and pit dimensions.
 - 9. Location and sizes of access doors, hoistway entrances and frames.

- C. Samples for Verification: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

- D. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

- E. Qualification Data: For Installer.

- F. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

- G. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

- H. Warranty: Special warranty specified in this Section.

- I. Continuing Maintenance Proposal: Service agreement specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- B. Source Limitations: Obtain elevators through one source from a single manufacturer.

1. Provide major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.
- C. Regulatory Requirements: Comply with ASME A17.1 and elevator design requirements for earthquake loads in ASCE 7.
1. Provide earthquake equipment required by ASME A17.1.
 2. Design earthquake spectral response acceleration, short period (Sds) for Project is as indicated on drawings.
 3. Project's seismic design category is A.
 4. Elevator importance factor is 1.25.
- D. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
- E. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.
 - B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.
- 1.7 COORDINATION
- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
 - B. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
 - C. Coordinate locations and dimensions of other work relating to electric traction elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits, machine rooms and hoistways.
- 1.8 WARRANTY
- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
 1. Warranty Period: One year from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.
 - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
 - a. Response Time: Two hours or less.
- B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard two-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product:
 - 1. Subject to compliance with requirements, provide the following:
 - a. Machine Room-less Gen2 Gearless Traction Elevator as manufactured by Otis Elevator Company.
 - 2. Subject to compliance with specifications and design intent a comparable product by one of the following manufacturers may be submitted for approval in accordance with provisions of Conditions of the Project and Division 1 Sections:
 - a. Schindler Elevator Corp.; 400A.
 - b. ThyssenKrupp Elevator; Synergy MRL.

2.2 SYSTEMS AND COMPONENTS

- A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.
- B. Elevator Machines: Provide variable-voltage, variable-frequency, ac-type hoisting machines. Provide solid-state power converters.
- C. Fluid for Oil Buffers: If oil buffers are used, use only fire-resistant hydraulic fluid containing antioxidant, anticorrosive, antifoaming, and metal-passivating additives.

1. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Hydro Safe (FR)" by Hydro Safe Oil Division, Inc.
- D. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.
- E. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 05 Section "Metal Fabrications" for materials and fabrication.
- F. Car Frame and Platform: Welded steel units.
- G. Guides: Provide roller guides or polymer-coated, nonlubricated sliding guides at top and bottom of car and counterweight frames.
- H. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.

2.3 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system for each elevator as required to provide type of operation system indicated.
- B. Single-Car Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
 1. Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. One car is returned at a time, with priority given to loaded cars. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at fire command station. Manual operation causes automatic operation to cease.
 2. Standby Powered Lowering: On activation of standby power, if car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the next floor below, opens its doors, and shuts down.
 3. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.
 4. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
- C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
 1. Card-Reader Operation: System uses card readers at car control stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space as required for card reader in car.

2.4 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.5 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- E. Stainless-Steel Bars: ASTM A 276, Type 304.
- F. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- G. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

2.6 CAR ENCLOSURES

- A. General: Provide enameled-steel car enclosures to receive removable wall panels, access doors, power door operators, and ventilation.
 - 1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
 - 2. Provide finished car including materials and finishes specified below.
- B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:
 - 1. Subfloor: Underlayment grade, exterior plywood, 5/8-inch (16-mm) nominal thickness; provide recessed cab floor as required to accommodate specified floor finish.
 - 2. Floor Finish: Thin-set Epoxy terrazzo flooring as specified in a Division 09.
 - 3. Stainless-Steel Wall Panels: Manufacturer's standard textured stainless steel wall panels.
 - 4. Fabricate car with recesses and cutouts for signal equipment.
 - 5. Fabricate car door frame integrally with front wall of car.
 - 6. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
 - 7. Sight Guards: Provide sight guards on car doors.
 - 8. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 - 9. Metal Ceiling: See Drawings for design and lighting configuration.
 - 10. Handrails: Manufacturer's standard tube railing, of metal, and finish indicated.

2.7 HOISTWAY ENTRANCES

- A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
- B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
 - 1. Stainless-Steel Frames: Formed from stainless-steel sheet.
 - 2. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
 - 3. Sight Guards: Provide sight guards on doors matching door edges.
 - 4. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 - 5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

2.8 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with LEDs.
- B. Car Control Stations: Provide manufacturer's standard recessed car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.
 - 1. Mark buttons and switches with standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
 - 2. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two-Way Telephone Communication Service: Provide telephone jack in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section "Fire Detection and Alarm."
- E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
 - 1. Include travel direction arrows if not provided in car control station.
- F. Hall Push-Button Stations: Provide one hall push-button station at each landing for each group of elevators.
 - 1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
 - 2. Equip units with buttons for calling elevator and for indicating desired direction of travel.

- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
 - 1. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
- H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
- I. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.
- J. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

2.9 ELEVATORS

A. Elevator Description: E1

- 1. Elevator Number: No. E1 (Gen2 3500)
- 2. Type: Gearless traction.
- 3. Rated Load: 3500 lb (1588 kg).
- 4. Rated Speed: 350 fpm (1.8 m/s).
- 5. Machine Location: Control Room at Third Floor.
- 6. No. of stops: 3
- 7. Operation System: Single car operation.
- 8. Auxiliary Operations:
 - a. Standby power operation.
 - b. Earthquake Emergency Operation: Comply with requirements in ASME A17.1.
 - c. Automatic dispatching of loaded car.
 - d. Nuisance call cancel.
 - e. Loaded-car bypass.
- 9. Car Enclosures:
 - a. Inside Width: 80 inches (2032 mm) from side wall to side wall.
 - b. Inside Depth: 65 inches (1651 mm) from back wall to front wall (return panels).
 - c. Inside Height: 96 inches (2438 mm).
 - d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish.
 - e. Car Fixtures: Satin stainless steel, No. 4 finish.
 - f. Side Wall Panels: Manufacturer's standard patterned stainless steel.
 - g. Rear Wall Panel: Manufacturer's standard patterned stainless steel.
 - h. Reveals: Satin stainless steel, No. 4 finish.
 - i. Door Faces (Interior): Satin stainless steel, No. 4 finish.
 - j. Door Sills: Aluminum, mill finish.
 - k. Ceiling: Satin stainless steel, No. 4 finish with low voltage downlights.
 - l. Handrails: 1-1/2 inches (38 mm) round satin stainless steel, No. 4 finish.
 - m. Floor prepared to receive specified epoxy terrazzo floor finish.

10. Hoistway Entrances: As follows:

- a. Width: 42 inches (1067 mm).
- b. Height: 84 inches (2134 mm).
- c. Type: Right hand opening.
- d. Fire-Protection Rating: 1-hour.
- e. Frames: Satin stainless steel, No. 4 finish.
- f. Doors: Satin stainless steel, No. 4 finish.
- g. Sills: Aluminum, mill finish.

11. Hall Fixtures: Satin stainless steel, No. 4 finish.

12. Additional Requirements:

- a. Provide blanket hooks in all cars and two complete set(s) of full-height protective blankets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to minimize transmission of vibrations to structure and thereby minimize structure-borne noise from elevator system.
- D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- F. Leveling Tolerance: 1/8 inch (3 mm), up or down, regardless of load and direction of travel.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

- H. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
 - 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
 - 2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.
- I. Within the shaft, all projections that are equal to or greater than 4 inches must be beveled at a 75 degree angle. Provide weld or bolted connections at beveled fabrications so that they are securely attached to shaft assembly thereby preventing a person from standing or laying tools or equipment on the projection as required by ASME A17.1

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for each elevator used for construction purposes:
 - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 - 2. Provide strippable protective film on entrance and car doors and frames.
 - 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
 - 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - 5. Do not load elevators beyond their rated weight capacity.
 - 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevators. Refer to Division 01 Section "Demonstration and Training."
- B. Check operation of each elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

- C. Check operation of each elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 142400



Montgomery College
endless possibilities

**Montgomery College - Rockville Campus
Science West Renovation & Addition**

Reference Documents, Not for Bid

Specifications – Volume III (3 of 4)

February 19, 2014

MHEC Project No. CC-01-414

MC Contract No. 533

Stantec Project No: 218310092

Reference Documents, Not for Bid

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SECTION 210500

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 RELATED DOCUMENTS

- A. Related Sections include the following:
 - 1. Division 21 Section "WATER-BASED FIRE-SUPPRESSION SYSTEMS".
 - 2. Division 28 Section "DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM" for alarm devices not specified in this Section.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. Fire-suppression equipment and piping demolition.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Painting and finishing.
 - 9. Concrete bases.
 - 10. Supports and anchorages.

1.4 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Mechanical sleeve seals.
 - 2. Escutcheons.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.8 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - a. Manufacturers:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.

- 3) Metraflex Co.
- 4) Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - a. Pressure Plates: Carbon steel. Include two for each sealing element.
 - b. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

- c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- L. Sleeves are not required for core-drilled holes.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Interior Joint Sealants" for materials and installation.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal all pipe penetrations with UL listed firestop assemblies. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Smoke Penetration Sealing: Fill the void opening around the item penetrating the wall with a noncombustible material such as mineral wool or another listed fill-void material. The fill void material shall have a coating of sealant applied and smoothed to close any gaps. The sealant shall be non-combustible or have a Class A flame spread combustibility rating.

- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions..
 - 1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.6 GROUTING

- A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 210500

SECTION 211000

WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following fire-suppression piping inside the building:
 - 1. Wet-pipe sprinkler systems.
- B. Related Sections include the following:
 - 1. Division 21 Section "COMMON WORK RESULTS FOR FIRE SUPPRESSION".
 - 2. Division 21 Section "ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS".
 - 3. Division 28 Section "DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM" for alarm devices not specified in this Section.

1.3 SUBMITTALS

- A. Include all shop drawings, hydraulic calculations, including flow test report, and product data in a single fire protection submission.
- B. Product Data for all products specified: Products include, but are not limited to, the following:
 - 1. Piping materials, including sprinkler specialty fittings.
 - 2. Pipe hangers and supports.
 - 3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 - 4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
 - 5. Alarm devices, including electrical data.
- C. Shop Drawings: Diagram all sprinkler piping. Diagram power, signal, and control wiring. Provide all applicable information as required by NFPA 13 under "Working Plans". Include elevation of all control valves and include stair and fire pump room sections.
- D. Fire-hydrant flow test report. Hydrant flow test data more than 12 months old from the date of contract award will not be accepted.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- G. Welding certificates.
- H. Field quality-control test reports.
- I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.4 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

- 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer licensed in Maryland and experienced in designing fire suppression systems that are similar in material design and extent or NICET Level IV technician.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

- 1. NFPA 13, "Installation of Sprinkler Systems." 2010 ed.

D. Performance Standards:

- 1. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- 2. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
- 3. Margin of Safety for Available Water Flow and Pressure: 10 percent or 10 psi (whichever is greater) safety margin. Include losses through water-service piping, valves, and backflow preventers. Safety margin percentage to be based on churn discharge pressure of combined water supply and fire pump, including adjustments for low gradient..
- 4. Available fire-hydrant flow test records indicate the following conditions:

- a. Date: 10/27/2011.
 - b. Performed by: The Protection Engineering Group, Inc.
 - c. Location of Static/Residual Test Fire Hydrant R: Hydrant FH-6
 - d. Elevation of Test Fire Hydrant R: 422 Feet
 - e. Location of Flow Fire Hydrant F: Hydrant FH-7
 - f. Static Pressure at Test Fire Hydrant R: 62 psig
 - g. Measured Flow at Flow Fire Hydrant F: 861 gpm
 - h. Residual Pressure at Test Fire Hydrant R: 55 psig
 - i. Low Gradient Elevation: 544 Feet
 - j. Adjusted Static Pressure: 53 psig
 - k. Adjusted Residual Pressure: 46 psig
5. Sprinkler Occupancy Hazard Classifications:
- a. Light Hazard. All areas, unless specifically notes otherwise on the contract drawings.
 - b. Ordinary Hazard, Group 1. Where indicated on contract drawings.
 - 1) Mechanical Equipment Rooms
 - 2) Electrical Equipment Rooms
 - 3) Storage Rooms
 - 4) Fire Access Room
 - 5) Custodian Closets
 - 6) IDF Rooms
 - 7) Utility
 - 8) Elevator Pit
 - 9) Elevator Machine Room
6. Minimum Density for Automatic-Sprinkler Piping Design:
- a. Light Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area. Unless reductions are taken via NFPA 13 requirements for quick response sprinklers.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area. Unless reductions are taken via NFPA 13 requirements for quick response sprinklers.
7. Maximum Protection Area per Sprinkler: Per UL listing.
8. Maximum Protection Area per Sprinkler:
- a. Office Spaces, Classrooms, Corridors: 225 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Elevator Machine Room: 130 sq. ft.
 - f. All Other Areas: Per NFPA 13.
9. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
- a. Light-Hazard Occupancies: 100 gpm for 30 minutes

- b. Ordinary-Hazard Occupancies: 250 gpm for 60 minutes.

1.6 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.

1.7 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufacturers are subject to compliance with the following Part requirements.

2.2 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard weight (Schedule 40) Steel Pipe, NPS 2 and smaller: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 - 3. Gray-Iron Threaded Fittings: ASME B16.4.
 - 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 5. Steel Threaded Couplings
- B. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 2½ to NPS 4; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory- or field-formed, roll-grooved ends. Grooved-End, Galvanized, Cut-Grooved, Schedule 40 Steel Pipe shall be utilized for piping between the fire department connection and the FDC check valve.
 - 1. Grooved-Joint Piping Systems:

- a. Available Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Ductilic, Inc.
 - 3) JDH Pacific, Inc.
 - 4) Southwestern Pipe, Inc.
 - 5) Tyco Fire Products
 - 6) Victaulic Co. of America.
 - 7) Ward Manufacturing.
- b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
- c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

2.3 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. Sprinkler Drain and Alarm Test Fittings: Bronze body; with threaded inlet and outlet, test valve, and orifice and sight glass. Include minimum ½" relief valve, set to operate at 175 psi.
 - 1. Available Manufacturers:
 - a. Fire-End and Croker Corp.
 - b. Tyco Fire Products
 - c. Viking Corp.
 - d. Victaulic Co. of America.
- C. Sprinkler Inspector's Test Fitting: Bronze housing with threaded inlet and drain outlet and sight glass.
 - 1. Available Manufacturers:
 - a. Tyco Fire Products
 - b. AGF Manufacturing Co.
 - c. G/J Innovations, Inc.
 - d. Triple R Specialty of Ajax, Inc.
 - e. Victaulic Co. of America

2.4 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed and FMG approved, with 175-psig minimum pressure rating.
- B. Ball Valves: Comply with UL 1091, except with ball instead of disc.
 - 1. NPS 1-1/2 and Smaller: Bronze body with threaded or grooved ends.

2. NPS 2 and NPS 2-1/2: Bronze body grooved ends.
 3. NPS 3: Ductile-iron body with grooved ends.
 4. Include additional padlock type lock on all control valves.
- C. Butterfly Valves: UL 1091.
1. NPS 2 and Smaller: Bronze body with threaded ends.
 - a. Available Manufacturers:
 - 1) Global Safety Products, Inc.
 - 2) Milwaukee Valve Company.
 - 3) Tyco Fire Products.
 - 4) Victaulic Co. of America.
 2. NPS 2-1/2 and Larger: Cast or Ductile iron body; grooved ends.
 - a. Available Manufacturers:
 - 1) Global Safety Products, Inc.
 - 2) McWane, Inc.; Kennedy Valve Div.
 - 3) Mueller Company.
 - 4) NIBCO.
 - 5) Tyco Fire Products.
 - 6) Victaulic Co. of America.
 3. Include additional padlock type lock on all control valves.
- D. Check Valves NPS 2 and Larger: UL 312, swing type, cast iron body with flanged or grooved ends.
1. Available Manufacturers:
 - a. AFAC Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Hammond Valve.
 - d. McWane, Inc.; Kennedy Valve Div.
 - e. Mueller Company.
 - f. NIBCO.
 - g. Potter-Roemer; Fire Protection Div.
 - h. Stockham.
 - i. United Brass Works, Inc.
 - j. Tyco Fire Products.
 - k. Victaulic Co. of America.
 - l. Watts Industries, Inc.; Water Products Div.
- E. Gate Valves: UL 262, OS&Y type.
1. NPS 2 and Smaller: Bronze body with threaded ends.
 - a. Available Manufacturers:
 - 1) Hammond Valve.
 - 2) NIBCO.
 - 3) Tyco Fire Products.
 - 4) United Brass Works, Inc.

2. NPS 2-1/2 and Larger: Cast iron body with flanged or grooved ends.
 - a. Available Manufacturers:
 - 1) Hammond Valve.
 - 2) McWane, Inc.; Kennedy Valve Div.
 - 3) Milwaukee Valve Company.
 - 4) Mueller Company.
 - 5) NIBCO.
 - 6) Red-White Valve Corp.
 - 7) United Brass Works, Inc.
 - 8) Victaulic Co.
 3. Include additional padlock type lock on all control valves.
- F. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch.
 2. NPS 2 and Smaller: Ball valve with bronze body.
 3. Include additional padlock type lock on all control valves.
 4. Available Manufacturers:
 - a. Milwaukee Valve Company.
 - b. NIBCO.
 - c. Tyco Fire Products.
 - d. Victaulic Co. of America.
- G. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; grooved ends.
1. Available Manufacturers:
 - a. Tyco Fire Products.
 - b. McWane, Inc.; Kennedy Valve Div.
 - c. Milwaukee Valve Company.
 - d. NIBCO.
 - e. Victaulic Co. of America.
 2. Include additional padlock type lock on all control valves.
- 2.5 BACKFLOW PREVENTERS
- A. Double-Check, Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.

- b. Conbraco Industries, Inc.; Apollo Valves.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
2. Standard: ASSE 1015.
 3. Operation: Continuous-pressure applications unless otherwise indicated.
 4. Pressure Loss: 4 psig maximum, through middle one-third of flow range.
 5. Size: NPS 6.
 6. Design Flow Rate: 350 gpm.
 7. Selected Unit Flow Range Limits: 1000 gpm.
 8. Pressure Loss at Design Flow Rate: 3 psig for NPS 6.
 9. Body Material: Stainless steel for NPS 2-1/2 and larger.
 10. End Connections: Flanged for NPS 2-1/2 and larger.
 11. Configuration: Designed for horizontal, straight through flow.
 12. Accessories: OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

2.6 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.7 SPECIALTY VALVES

- A. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.
 1. Available Manufacturers:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire Products.
 - d. Viking Corporation.
- B. Sprinkler Riser Manifold Assemblies: All components shall be UL listed and FMG approved, with 175-psig minimum pressure rating.
 1. Available Manufacturers:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire Products.
 - c. Victualic Company.
 - d. Viking Corporation

- C. Relief Valves: All components shall be UL listed and FMG approved, with 175-psig minimum pressure rating.
 - 1. Available Manufacturers:
 - a. AGF Manufacturing Co.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire Products
 - d. Viking Corporation
 - e. Victaulic Co. of America

2.8 SPRINKLERS

- A. Sprinklers shall be UL listed and FMG approved, with 175-psig minimum pressure rating. Quick-response Sprinklers shall be used throughout the entire building, unless prohibited by application.
- B. Available Manufacturer:
 - 1. AFAC Inc.
 - 2. Globe Fire Sprinkler Corporation.
 - 3. Reliable Automatic Sprinkler Co., Inc.
 - 4. Tyco Fire & Building Products LP.
 - 5. Victaulic Company.
 - 6. Viking Corporation.
- C. Automatic Sprinklers: With heat-responsive element complying with the following:
 - 1. UL 199, for nonresidential applications.
- D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- E. Sprinkler types (All quick-response), features, and options as follows:
 - 1. Pendent sprinklers.
 - 2. Recessed sprinklers, including escutcheon.
 - 3. Sidewall sprinklers.
 - 4. Upright sprinklers.
 - 5. Dry-type sprinklers.
- F. Sprinkler Finishes: Chrome plated, bronze, and painted.
- G. Special Coatings: Wax, lead, and corrosion-resistant paint.
- H. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.9 FIRE DEPARTMENT CONNECTIONS

- A. Standard: UL 405.
- B. Type: Flush, for wall mounting.
- C. Pressure Rating: 175 psig minimum.
- D. Body Material: Corrosion-resistant metal.

- E. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- F. Caps: Brass, lugged type, with gasket and chain.
- G. Escutcheon Plate: Rectangular, brass, wall type.
- H. Outlet: Back, with pipe threads.
- I. Body Style: Horizontal
- J. Number of Inlets: Two.
- K. Escutcheon Plate Marking: "AUTO SPKR"
- L. Finish: Polished chrome plated.
- M. Outlet Size: NPS 4.

2.10 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac minimum and 0.25 A, 24-V dc minimum; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 1. Available Manufacturers:
 - a. Potter Electric Signal Company.
 - b. System Sensor.
 - c. Tyco Fire Products
 - d. Viking Corp.
 - e. Watts Industries, Inc.; Water Products Div.
- C. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
 - 1. Available Manufacturers:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. Potter Electric Signal Company.
 - c. System Sensor.

2.11 PRESSURE GAGES

- A. Available Manufacturers:
 - 1. AGF Manufacturing Co.
 - 2. AMETEK, Inc.; U.S. Gauge.
 - 3. Brecco Corporation.
 - 4. Dresser Equipment Group; Instrument Div.

5. Marsh Bellofram.
 6. WIKA Instrument Corporation.
- B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.
1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.

PART 3 EXECUTION

3.1 PREPARATION

- A. Perform a fire-hydrant flow test according to NFPA 13 and NFPA 291 utilizing a minimum of 2 fire hydrants, one test hydrant and one flow hydrant. Take into account City of Rockville low gradient. Use results for system design calculations required in Part 1 "Quality Assurance" Article. The flow test shall be performed prior to sprinkler system design and submission.
- B. Report fire hydrant test results to the Architect within 5 days of the flow test and in writing.

3.2 EXAMINATION

- A. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for sprinkler zone control assemblies, and other conditions where sprinkler zone control assemblies and fire-rated access doors are to be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected. Coordinate locations of sprinkler zone control assemblies and fire-rated access doors with stairway wall construction.

3.3 PIPING APPLICATIONS, GENERAL

- A. Shop-weld pipe joints where welded piping is indicated.
- B. Do not use welded joints for galvanized-steel pipe.
- C. Flanges, flanged fittings, unions, grooved joint couplings, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- D. Piping between Fire Department Connections and Check Valves: Galvanized, Schedule 40 steel pipe with cut-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.4 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:
 1. NPS 2 and Smaller: Threaded-end, black, standard-weight Schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
 2. NPS 2-1/2 and larger: Grooved-end, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.5 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13.
 - a. Shutoff Duty: Use indicating-type ball, butterfly, or gate valves.
 - 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and NFPA 14.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
 - b. Throttling Duty: Use ball or globe valves.

3.6 JOINT CONSTRUCTION

- A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe larger than NPS 2 that has a wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
 - 2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
 - 3. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by the grooved coupling manufacturer.
 - 4. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing.
 - 5. Grooved coupling manufacturer's factory trained field representative shall provide on-site training to contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.
 - 6. If the galvanized coating is found to chip or crack upon roll-grooving of joint, two coats of liquid galvanized material shall be applied to the groove.

3.7 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- C. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- D. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- E. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- F. Install sprinkler piping with drains for complete system drainage.
- G. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to the sprinkler riser. Each floor's sprinkler zone control valve assembly to utilize a sprinkler riser manifold assembly to save space and shall be located in the stair wall chase with a 30-inch x 30-inch fire rated access panel/door, accessible from the stair. Each floor's sprinkler system shall also include a 1/2-inch relief valve set to operate at 175 psi.
- H. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- I. Install alarm devices in piping systems.
- J. Hangers and Supports: Comply with NFPA 13 for hanger materials.
 1. Install sprinkler system piping according to NFPA 13.
 2. If the maximum static or flowing pressure exceeds 100 psi, based on flow test actual flow test results not including low gradient, sprinkler hanger requirements shall also comply with those applicable sections of NFPA 13.
- K. Install pressure gages on riser or feed main and at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- L. Fill wet-pipe sprinkler system piping with water.

3.8 VALVE INSTALLATION

- A. Install listed fire-protection shutoff valves supervised-open, with additional lock, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

3.9 SPRINKLER APPLICATIONS

- A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Concealed sprinklers.
 3. Wall Mounting: Sidewall sprinklers.
 4. Sprinkler Finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
 - b. Concealed Sprinklers: Rough brass, factory-painted plate. Color to be determined by Architect during shop drawing review process.

3.10 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles in both directions.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing (vestibules). Use dry-type sprinklers with water supply from heated space if applicable.

3.11 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect to water-supply piping in Fire Access 133. Provide backflow preventor at connection to water-supply piping.
- D. Connect piping to specialty valves, specialties, and accessories.
- E. Electrical Connections: Power wiring is specified in Division 26.
- F. Connect alarm devices to fire alarm.
- G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- I. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.12 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and any more stringent requirements of utilities identification specification sections for this project.
- B. All final labeling of all fire protection equipment, control valves and drains shall be coordinated with the College's finished room numbers as defined in the architectural drawing series A200 and A430. Construction room numbers shall not be used for final labeling.
- C. Paint exposed piping and equipment as indicated in Division 9 Section "INTERIOR PAINTING" and "EXTERIOR PAINTING" for painting of piping and equipment.
- D. Provide a copy of the as-built sprinkler shop drawings in Fire Access 133. The plans shall be protection from deformation and located in a dedicated, labeled, locked storage cabinet provided by contractor and permanently mounted to the wall adjacent to the main sprinkler riser.
- E. Provide sprinkler system pipe labels, sprinkler system control valve tags, including valve chart, and hydraulic calculation placards.
 - 1. Piping labels shall be provided at maximum of 50-foot intervals, near each control valve, near penetrations through walls, floors and at access doors.
 - 2. Valve tags shall be 1-1/2 inches, round, and the valve chart shall be mounted in Fire Access 133.
 - 3. Locate hydraulic calculation placards at each sprinkler system zone control assembly.

3.13 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Energize circuits to electrical equipment and devices.
 - 4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter and the City of Rockville requirements, including all pre and final testing per the Rockville FPEDE. Provide "Contractor's Material and Test Certificate for Aboveground Piping" for all systems.
 - 5. Coordinate with fire alarm tests. Operate as required.
 - 6. Verify that equipment hose threads are same as local fire department equipment.
- B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.14 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

- C. Protect sprinklers from damage until Substantial Completion.

3.15 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 211000

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Split-case fire pumps.
 - 2. Fire-pump accessories and specialties.
- B. Related Sections include the following:
 - 1. Division 21 Section "COMMON WORK RESULTS FOR FIRE SUPPRESSION".
 - 2. Division 21 Section "WATER-BASED FIRE-SUPPRESSION SYSTEMS".
 - 3. Division 21 Section "CONTROLLERS FOR FIRE-PUMP DRIVERS".
 - 4. Division 28 Section "DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM" for alarm devices not specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

- A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig minimum unless higher pressure rating is indicated.

1.4 ACTION SUBMITTALS

- A. Include all fire pump shop drawings and product data in a single fire protection submission.
- B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
- C. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each fire pump, from manufacturer.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 (2011 ed.), by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection." 2010 ed.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS

- A. Description: Factory-assembled and -tested fire-pump and driver unit.
- B. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.
- C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.
- D. UL Listed and FM Approved.

2.2 HORIZONTALLY MOUNTED, SINGLE-STAGE, SPLIT-CASE FIRE PUMPS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. A-C Fire Pump Systems; a business of ITT Industries.
 - 2. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
 - 3. PACO Pumps; Grundfos Pumps Corporation, U.S.A.

4. Peerless Pump, Inc.
5. Pentair Pump Group; Aurora Pump.
6. S.A. Armstrong Limited.

B. Pump:

1. Standard: UL 448, for split-case pumps for fire service.
2. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Wear Rings: Replaceable bronze.
5. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
6. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.

C. Coupling: Capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard. Elastomeric couplings not acceptable.

D. Driver:

1. Standard: UL 1004A.
2. Type: Electric motor; NEMA MG 1, polyphase Design B.

E. Capacities and Characteristics:

1. Rated Capacity: 500 gpm.
2. Total Rated Head: 40 psig.
3. Inlet Flange: Class 125.
4. Outlet Flange: Class 125.
5. Motor Horsepower: 20 HP
6. Motor Speed: 3650 rpm.
7. Electrical Characteristics:
 - a. Volts: 460.
 - b. Phase: Three.
 - c. Hertz: 60.
8. Pump-Start, Pressure-Switch Setting: 80 psig. Base final pump start pressure on NFPA 20 requirements and current flow test results.
9. Pump-Stop, Pressure-Switch Setting: manual.

2.3 FIRE-PUMP ACCESSORIES AND SPECIALTIES

- A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
- B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.

- C. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
- D. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.
- E. Hose Valve Manifold Assembly:
 - 1. Standard: Comply with requirements in NFPA 20.
 - 2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
 - 3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
 - 4. Automatic Drain Valve: UL 1726.
 - 5. Manifold:
 - a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
 - b. Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
 - c. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
 - d. Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - e. Escutcheon Plate: Brass or bronze; rectangular.
 - f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - g. Exposed Parts Finish: Polished, chrome plated.
 - h. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

2.4 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
 - 1. Verification of Performance: Rate fire pumps according to UL 448.
- B. Fire pumps will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
- B. Equipment Mounting:
 - 1. Install fire pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03 Section "Cast-in-Place Concrete" and Division 21 Section "Common Work Results for Fire Suppression".
- C. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
- D. Support piping and pumps separately so weight of piping does not rest on pumps.
- E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Section 211000 "Water-Based Fire-Suppression Systems."
- F. Install pressure gages on fire-pump suction and discharge flange pressure-gage tapings. Comply with requirements for pressure gages specified in Section 211000 "Water-Based Fire-Suppression Systems."
- G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
- H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- I. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

3.3 ALIGNMENT

- A. Align split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.

- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

3.4 CONNECTIONS

- A. Comply with requirements for piping and valves specified in Section 211000 "Water-Based Fire-Suppression Systems." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect fire pumps to their controllers.

3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

3.6 FIELD QUALITY CONTROL

- A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Section 213900 "Controllers for Fire-Pump Drivers."
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform all acceptance tests and inspections as required by NFPA 20 and the manufacturer.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
 - 2. Test according to NFPA 20 for acceptance and performance testing and per the City of Rockville requirements, including all pre and final testing per the Rockville FPEDE.
 - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

- 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

END OF SECTION 213113

SECTION 213400 - PRESSURE-MAINTENANCE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Multistage, pressure-maintenance pumps.
- B. Related Section:
 - 1. Section 213900 "Controllers for Fire-Pump Drivers" for pressure-maintenance-pump controllers.

1.3 PERFORMANCE REQUIREMENTS

- A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig minimum unless higher pressure rating is indicated.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For pumps, accessories, and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 (2011 ed.), by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection." 2010 ed.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 MULTISTAGE, PRESSURE-MAINTENANCE PUMPS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. A-C Fire Pump Systems; a business of ITT Industries.
 2. Grundfos Management A/S; Grundfos Pumps Corporation U.S.A.
 3. PACO Pumps; Grundfos Pumps Corporation U.S.A.
 4. TACO Incorporated.
- B. Description: Factory-assembled and -tested, multistage, barrel-type vertical pump as defined in HI 2.1-2.2 and HI 2.3; designed for surface installation with pump and motor direct coupled and mounted vertically.
- C. Pump Construction:
1. Barrel: Stainless steel.
 2. Suction and Discharge Chamber: Cast iron with flanged inlet and outlet.
 3. Pump Head/Motor Mount: Cast iron.
 4. Impellers: Stainless steel, balanced, and keyed to shaft.
 5. Pump Shaft: Stainless steel.
 6. Seal: Mechanical type with carbon rotating face and silicon-carbide stationary seat.
 7. Intermediate Chamber Bearings: Aluminum-oxide ceramic or bronze.
 8. Chamber-Base Bearing: Tungsten carbide.
 9. O-Rings: EPDM or NBR.
- D. Motor: Single speed with permanently lubricated ball bearings and rigidly mounted to pump head.

- E. Nameplate: Permanently attached to pump and indicating capacity and characteristics.
- F. Capacities and Characteristics:
 - 1. Rated Capacity: 5 gpm.
 - 2. Total Rated Head: 50 psig.
 - 3. Working Pressure: 175-psig minimum
 - 4. Inlet and Outlet Size: NPS 1-1/4.
 - 5. Discharge and Suction Flanges: Class 125.
 - 6. Motor Horsepower: 3/4
 - 7. Motor Speed: 3650
 - 8. Electrical Characteristics:
 - a. Volts: 460
 - b. Phases: Three.
 - c. Hertz: 60.
 - 9. Pump-Start, Pressure-Switch Setting: 90 psig. Base final pump start pressure on NFPA 20 requirements and current flow test results.
 - 10. Pump-Stop, Pressure-Switch Setting: 100 psig. Base final pump start pressure on NFPA 20 requirements and current flow test results.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motor.
 - 1. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.
- B. Base-Mounted Pump Mounting: Install pumps on concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete" and Division 21 Section "Common Work Results for Fire Suppression".
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Attach pumps to equipment base using anchor bolts.

- C. Install multistage pressure-maintenance pumps according to HI 1.4.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform all acceptance tests and inspections as required by NFPA 20, the manufacturer and the City of Rockville requirements, including all pre and final testing per the Rockville FPEDE.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Pressure-maintenance pumps will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.3 ADJUSTING

- A. Lubricate pumps as recommended by manufacturer.
- B. Set field-adjustable pressure-switch ranges as indicated.

END OF SECTION 213400

SECTION 213900 - CONTROLLERS FOR FIRE-PUMP DRIVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Full-service, full-voltage controllers rated 600 V and less.
 - 2. Controllers for pressure-maintenance pumps.
- B. Related Sections include the following:
 - 1. Division 21 Section "COMMON WORK RESULTS FOR FIRE SUPPRESSION".
 - 2. Division 21 Section "WATER-BASED FIRE-SUPPRESSION SYSTEMS".
 - 3. Division 21 Section "ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS".
 - 4. Division 28 Section "DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM" for alarm devices not specified in this Section.

1.3 DEFINITIONS

- A. ATS: Automatic transfer switch.
- B. ECM: Electronic control module.
- C. MCCB: Molded-case circuit breaker.
- D. N.O.: Normally open.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.

- b. Enclosure types and details for types other than NEMA 250, Type 2.
 - c. Factory-installed devices.
 - d. Nameplate legends.
 - e. Short-circuit current (withstand) rating of integrated unit.
 - f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
 - g. Specified modifications.
2. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.
 3. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Certificates: For each type of product indicated, from manufacturer.
- C. Manufacturer's factory test reports of fully assembled and tested equipment.
- D. Source quality-control reports.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product indicated to include in emergency, operation, and maintenance manuals and including the following:
 1. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Indicating Lights: Two of each type and color of lens installed; two of each type and size of lamp installed.
 2. Auxiliary Contacts: One for each size and type of magnetic contactor installed.
 3. Power Contacts: Three for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of an NRTL.

- B. Source Limitations: Obtain fire-pump controllers and all associated equipment from single source or producer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with standards of authorities having jurisdiction pertaining to materials and installation.
- E. Comply with NFPA 20, 2010 ed., and NFPA 70, 2011 Ed.
- F. UL Listed and FM Approved.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Ambient Temperature Rating: Not less than 40 deg F and not exceeding 122 deg F unless otherwise indicated.
 - 2. Altitude Rating: Not exceeding 6600 feet unless otherwise indicated.

1.11 COORDINATION

- A. Coordinate layout and installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 FULL-SERVICE CONTROLLERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Aquarius Fluid Products, Inc.
 - 2. ASCO Power Technologies, LP; Firetrol Products.
 - 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 4. Hubbell Incorporated; Hubbell Industrial Controls.
 - 5. Joslyn Clark Corporation.

6. Master Control Systems, Inc.
7. Metron, Inc.

B. General Requirements for Full-Service Controllers:

1. Comply with NFPA 20 and UL 218.
2. Listed by an NRTL for electric-motor driver for fire-pump service.
3. Combined automatic and nonautomatic operation.
4. Factory assembled, wired, and tested; continuous-duty rated.
5. Service Equipment Label: NRTL labeled for use as service equipment.

C. Method of Starting:

1. Pressure-switch actuated.
 - a. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
 - b. System pressure recorder, electric ac driven, with spring backup.
 - c. Programmable minimum-run-time relay to prevent short cycling.
 - d. Programmable timer for weekly tests.
2. Magnetic Controller: Across-the-line type.
3. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.

D. Method of Stopping: Nonautomatic.

E. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.

F. Method of Isolation and Overcurrent Protection: Interlocked isolating switch and nonthermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.

G. Door-Mounted Operator Interface and Controls:

1. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
2. Method of Control and Indication:
 - a. Microprocessor-based logic controller, with multiline digital readout.
 - b. Membrane keypad.
 - c. LED alarm and status indicating lights.
3. Local and Remote Alarm and Status Indications:
 - a. Controller power on.
 - b. Motor running condition.
 - c. Loss-of-line power.
 - d. Line-power phase reversal.
 - e. Line-power single-phase condition.

4. Audible alarm, with silence push button.
5. Nonautomatic START and STOP push buttons or switches.

H. Optional Features:

1. Extra Output Contacts:
 - a. One N.O. contact(s) for motor running condition.
 - b. One set(s) of contacts for loss-of-line power.
2. Local alarm bell.
3. Door-mounted thermal or impact printer for alarm and status logs.
4. Operator Interface Communications Ports: USB, Ethernet, and RS485.

I. ATS:

1. Complies with NFPA 20, UL 218, and UL 1008.
2. Integral with controller as a listed combination fire-pump controller and power transfer switch.
3. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
4. Allows manual transfer from one source to the other.
5. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
6. Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.
7. Local and Remote Alarm and Status Indications:
 - a. Normal source available.
 - b. Alternate source available.
 - c. In normal position.
 - d. In alternate position.
 - e. Isolating means open.
8. Audible alarm, with silence push button.
9. Nonautomatic (manual, nonelectric) means of transfer.
10. Engine test push button.
11. Start generator output contacts.
12. Timer for weekly generator tests.

2.2 CONTROLLERS FOR PRESSURE-MAINTENANCE PUMPS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Aquarius Fluid Products, Inc.
 2. ASCO Power Technologies, LP; Firetrol Products.
 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

4. Hubbell Incorporated; Hubbell Industrial Controls.
5. Joslyn Clark Corporation.
6. Master Control Systems, Inc.
7. Metron, Inc.

B. General Requirements for Pressure-Maintenance-Pump Controllers:

1. Type: UL 508 factory assembled, wired, and tested, across-the-line; for combined automatic and manual operation.
2. Enclosure: UL 508 and NEMA 250, Type 2 for wall-mounting.
3. Factory assembled, wired, and tested.
4. Finish: Manufacturer's standard color paint.

C. Rate controller for scheduled horsepower and include the following:

1. Fusible disconnect switch.
2. Pressure switch.
3. Hand-off-auto selector switch.
4. Pilot light.
5. Running period timer.

2.3 ENCLOSURES

A. Fire-Pump Controllers, ATS, and Remote Alarm Panels: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.

1. Indoor, Dry and Clean Locations: Type 1 (IEC IP10).

B. Enclosure Color: Manufacturer's standard "fire-pump-controller red".

C. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.

D. Optional Features:

1. Floor stands, 12 inches high, for floor-mounted controllers.

2.4 SOURCE QUALITY CONTROL

A. Testing: Test and inspect fire-pump controllers according to requirements in NFPA 20 and UL 218.

1. Verification of Performance: Rate controllers according to operation of functions and features specified.

B. Fire-pump controllers will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive equipment, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROLLER INSTALLATION

- A. Install controllers within sight of their respective drivers.
- B. Connect controllers to their dedicated pressure-sensing lines.
- C. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79 inches above finished floor, and bottom of enclosure not less than 12 inches above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- D. Floor-Mounting Controllers: Install controllers on 4-inch nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches above finished floor. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete" and Division 21 Section "Common Work Results for Fire Suppression".
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- F. Comply with NEMA ICS 15.

3.3 POWER WIRING INSTALLATION

- A. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 CONTROL AND ALARM WIRING INSTALLATION

- A. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Section 283111 "Digital, Addressable Fire-Alarm System."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect remote manual and automatic activation devices where applicable.

3.5 IDENTIFICATION

- A. Comply with requirements in NFPA 20 for marking fire-pump controllers.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
 - 1. Inspect and Test Each Component:
 - a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
 - b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
 - c. Test continuity of each circuit.
 - 2. Verify and Test Each Electric-Driver Controller:
 - a. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify Architect and Construction Manager before starting the motor(s).
 - b. Test each motor for proper phase rotation.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Field Acceptance Tests:

1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Architect, Construction Manager and authorities having jurisdiction.
2. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
3. Engage manufacturer's factory-authorized service representative to be present during the testing.
4. Perform field acceptance tests as outlined in NFPA 20 and as required per the manufacturer and the City of Rockville requirements, including all pre and final testing per the Rockville FPEDE.

F. Controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. Adjust controllers to function smoothly and as recommended by manufacturer.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.

C. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

D. Set field-adjustable pressure switches.

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controllers, remote alarm panels, and to use and reprogram microprocessor-based controls within this equipment.

END OF SECTION 213900

SECTION 220000 - GENERAL PLUMBING PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Scope of Work.
 - 2. Intent of Drawings.
 - 3. Discrepancies in Documents
 - 4. Pre-Bid Site Visit.
 - 5. Definitions.
 - 6. General Standards of Materials.
 - 7. Products and Substitutions.
 - 8. Applicable Codes.
 - 9. Guarantees and Certificates.
 - 10. Quiet Operation and Vibration Control.
 - 11. Coordination.
 - 12. Shop Drawings, Product Data, and Samples.
 - 13. Owner Instruction.

1.3 SCOPE OF WORK

- A. The scope of the work included under Division 22 of the specifications shall include complete systems as shown in the Contract Documents and specified herein. Any work reasonably inferable or required to result in a complete installation or the intended operation and performance of the systems, shall be included in the Base Bid except where there is specific reference to exclusion and incorporation in other quotations.
- B. A brief written Scope of Work appears in Division 1.

1.4 INTENT OF DRAWINGS

- A. Provide complete and functional systems for the project. The systems shall conform to the details stated in the specifications and shown on the drawings. Items or work not shown or specified, but required for complete systems, shall be provided and conform to accepted trade practices. The drawings and specifications are presented to define specific system requirements and serve to expand on the primary contract requirements of providing complete systems. The drawings are diagrammatic and indicate the general arrangement and routing of the systems included in this contractors work.
- B. Do not scale the drawings. Because of the scale of the drawings, it is not possible to indicate offsets, fittings, valves, or similar items which may be required to provide complete operating systems. Carefully investigate conditions affecting the work associated with this project. Install systems in such a manner that interferences between pipes, conduit, ducts, equipment,

architectural and structural features are avoided. Provide items required to meet the project conditions without additional cost to the owner.

- C. These documents may not explicitly disclose final details required for a complete systems installation; however, contractors shall possess the expertise to include the necessary appointments of complete operating systems.
- D. Contractors shall be "Experienced" (as defined in Division 1) in this type of construction and realize the extent of the work required.

1.5 DISCREPANCIES IN DOCUMENTS

- A. If drawings or specifications conflict or are unclear, the Plumbing Contractor shall advise Architect / Engineer in writing before award of contract. Otherwise, Architects / Engineers interpretation of contract documents shall be final, and no additional compensation shall be permitted due to discrepancies or clarifications.
- B. Where drawings or specifications do not coincide with manufacturers' recommendations or with applicable codes and standards, the Plumbing Contractor shall advise Architect / Engineer in writing before installation. Otherwise, contractor shall be responsible to provide revisions to their work as directed by architect / engineer within contract price.
- C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specifications, the Plumbing Contractor shall provide material, installation, or work which is of the higher standard.
- D. It is the intent of these contract documents to have the Plumbing Contractor to provide systems and components that are complete and operational for the intended use. If the Plumbing Contractor discovers a discrepancy or requires a clarification and has failed to notify the Architect / Engineer of the situation in accordance with Paragraph (A) above, the Plumbing Contractor shall provide the specific systems or components within contract price.
- E. In cases covered by Paragraph (D) above, where the Plumbing Contractor believes direction or clarification is required from the Architect / Engineer, the Plumbing Contractor shall submit a sketch identifying the issued and a proposed solution. The Architect / Engineer will review proposed solution, note if necessary, and return.

1.6 PRE-BID SITE VISIT

- A. Bidders shall visit the site and become completely familiar with existing conditions prior to submitting their bid. No extra charges shall be allowed as a result of existing conditions. Schedule a site visit at least 48 hours in advance of desired time of visit.

1.7 DEFINITIONS

- A. Specific terminology, as used herein, shall have the following meanings:
 - 1. "Furnish"...Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar subsequent requirements.
 - 2. "Install"...Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar requirements.

3. "Provide"...Furnish and install, complete and ready for intended use.
4. "Concealed, Interior"...Concealed from view and protected from physical contact by building occupants.
5. "Concealed, Exterior" ...Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures.
6. "Exposed, Interior"...Exposed to view indoors (not concealed).
7. "Exposed, Exterior"...Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
8. "Finished Space" ...Space other than mechanical rooms, electrical rooms, furred spaces, pipe chases, unheated spaces immediately below roof, space above ceilings, unexcavated spaces, crawl spaces, tunnels, and interstitial spaces.
9. "Conditioned"...Spaces directly provided with heating and cooling.
10. "Unconditioned"...Spaces without heating or cooling including ceiling plenums.
11. "Indoors"...Located inside the exterior walls and roof of the building.
12. "Outdoors"...Located outside the exterior walls and roof of the building.
13. "Atmosphere"...The same as outdoors.

1.8 GENERAL STANDARDS OF MATERIALS

- A. Equipment and materials, unless otherwise noted, shall be new and of first quality, produced by manufacturers who have been regularly engaged in the manufacture of these products for a period of not less than five years.
- B. Equipment of one type shall be the products of one manufacturer; similar items of the same classification shall be identical, including equipment, assemblies, parts and components.
- C. Materials furnished shall be determined safe by a nationally recognized testing organization, such as Underwriters' Laboratories, Inc., or Factory Mutual Engineering Corporation, and materials shall be labeled, certified or listed by such organizations. Third party certification is required for backflow prevention, safety devices and packaged equipment, all these shall bear the appropriate certification label.
- D. With respect to custom made equipment or related installations which are constructed specially for this project, the manufacturer shall certify the safety of same on the basis of test data. The Owner shall be furnished copies of such certificates.

1.9 PRODUCTS AND SUBSTITUTIONS

- A. Where a specific manufacturer's product is specified, the Contract Amount shall be based on that product only.
- B. Where several manufacturers' products are specified, the Contract Amount shall be based upon the specified products only.

1.10 CODES, PERMITS AND INSPECTIONS

- A. Materials furnished and work installed shall comply with the International Plumbing Code, the International Building Code, the International Energy Conservation Code, the National Fire Protection Association, requirements of the local utility companies, and with authorities having jurisdiction. Materials and equipment furnished for the electrical portion of the plumbing systems shall comply with the National Electrical Code and bear the approval label of or shall be listed by the Underwriters' Laboratories, Inc.
- B. Plumbing Contractor shall provide labor, materials, services, apparatus and drawings required to comply with applicable laws, ordinances, rules and regulations, whether or not shown on the drawings and/or specified.
- C. Plumbing contractor shall obtain and pay for required permits associated with approval and installation of plumbing systems and associated appurtenances.

1.11 GUARANTEES AND CERTIFICATES

- A. Defective equipment, materials or workmanship, including damage to the work provided under other divisions of this contract, shall be replaced or repaired at no extra cost to the Owner for the duration of the stipulated guarantee periods.
 - 1. Unless specifically indicated otherwise, the duration of the guarantee period shall be one (1) year following the date of Substantial Completion. Temporary operation of the equipment for temporary conditioning, testing, etc., prior to occupancy will not be considered part of the warranty period.

1.12 QUIET OPERATION AND VIBRATION CONTROL

- A. Equipment and associated items shall operate under conditions of load without sound or vibration deemed objectionable by the Architect. In the case of moving equipment, sound or vibration noticeable outside of the room in which it is installed, or noticeable within the room in which it is installed, shall be deemed objectionable. Sound or vibration deemed objectionable shall be corrected in an approved manner. Vibration control shall be provided by means of approved vibration isolators and installed in accordance with the isolator manufacturer's recommendations.
- B. The sound pressure levels around plumbing equipment (pumps, motors, etc.) in equipment spaces shall not exceed 85 dBA at any point three (3) feet from the equipment, with all equipment in the room operating. The sound criteria applies to the complete range of each piece of equipment.

1.13 COORDINATION

- A. Coordinate and furnish in writing to the Architect information necessary to permit the work to be installed satisfactorily and with the least possible interference or delay.
- B. Coordination drawings shall be prepared as defined in Division 1. No installation of permanent systems shall proceed until the coordination drawings are reviewed by the Architect. No extra charges shall be allowed for changes required to accommodate installation of systems provided under other divisions of this contract.
- C. Coordination drawings shall be developed from individual system shop drawings and contractor

fabrication drawings. Electronic or other reproduced engineering design drawings used as coordination drawings are not acceptable.

- D. When work is installed without proper coordination, changes to this work deemed necessary by the Architect shall be made to correct the conditions without extra cost to the Owner.

1.14 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. Shop drawings, product data, and samples shall be submitted in accordance with the provisions of Division 1.

- B. The following shall be submitted by the Contractor for review:

1. Scale shop drawings showing system components with sizing indicated, including but not limited to:
 - a. Equipment locations.
 - b. Fixtures and trim
 - c. Piping
 - d. Insert and sleeve locations
 - e. Hangers, anchors and guides
 - f. Expansion joints and loops
 - g. Access doors and panels
2. Product data for system components and materials (including construction standards).
3. Samples of finishes and trim exposed to view, such as cleanout plates, fixture trim, escutcheon plates and similar items.

1.15 OWNER INSTRUCTION

- A. After final tests and adjustments have been completed, furnish the services of qualified personnel to instruct representatives of the Owner in the operation and maintenance procedures for equipment and systems installed as part of this project. Operation and maintenance instructions for major items of equipment shall be directly supervised by the equipment manufacturer's representative. Supply qualified personnel to operate equipment for sufficient length of time as required to meet governing authorities' operation and performance tests and as required to assure that the Owner's representatives are properly qualified to take over operation and maintenance procedures. Minimum instruction period shall be 80 man hours. The instruction period shall be broken into segments at the discretion of the Owner.
 1. Notify the Architect, the Owner's representative and equipment manufacturers' representatives, by letter, as to the time and date of operating and maintenance instruction periods approved by the Owner at least one (1) week prior to conducting same.
 2. Forward to the Architect the signatures of all those present for the instruction periods.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 220000

SECTION 220500 - COMMON WORK FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Excavating and Backfilling.
 - 2. Waterproofing.
 - 3. Air Plenums.
 - 4. Electrical Connections and Protection.
 - 5. Accessibility.
 - 6. Painting.
 - 7. Equipment Foundations, Supports, Piers, and Attachments.
 - 8. Cleaning, Protection and Adjustment.
 - 9. Special Tools.
 - 10. Welding.
 - 11. Dielectric Fittings
 - 12. Piping connections
 - 13. Expansion joints
 - 14. Site Water System Flow Test
 - 15. Third-Party Testing and Certification.

1.3 EXCAVATING AND BACKFILLING

- A. Excavate and backfill as required for the installation of this work.
- B. Trenches for underground piping shall be excavated to required depths. Where rock is encountered, excavate to a grade 6 inches below the lowest part of the pipe and refill the excavation below pipe grade with sand and gravel. Trenches shall have uniform grade as specified hereafter or shown on the drawings.
- C. Pipe trenches shall not be wider than 4 inches on each side of the pipe but not less than 12 inches wide.
- D. Excavations shall be done on an unclassified basis. No extras shall be allowed regardless of type or hardness of material encountered.
- E. No backfilling shall be done on any plumbing system requiring testing or inspection until such testing or inspection has been completed satisfactorily.
- F. Shore and brace as required to maintain banks of excavation and avoid cave-ins and make good any damages to adjoining property or work in place caused by failure to properly shore excavations. Shoring shall conform to OSHA and Department of Labor and Industry requirements.

- G. Backfilling shall be made in 8 inch layers (maximum), mechanically tamped. Wood, old forms, shoring, etc., shall be removed before backfilling. Backfill shall not contain any frozen material, ashes, slag, combustible material, rocks over 6 inches in the largest dimension, or any other material which the Architect considers unsuitable for the purpose. Particular care shall be exercised in backfilling areas where construction shall be placed above the backfill.
- H. Satisfactory soil materials for backfill where contaminated soil is removed whether surplus from the existing site or trucked-in new shall meet the following requirements:
 - 1. ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM free from rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- I. Compaction of soil and backfill shall be as follows:
 - 1. Soil and backfill shall be compacted in 8 inch layers (maximum) with each layer of soil or backfill compacted at 95 percent maximum dry density according to ASTM D 1557.
- J. Shoring shall be removed after equipment and piping have been installed and tested.
- K. Keep available at all times pumping equipment which shall be used to pump any or water from pipe trenches and excavation under this Contract.
- L. Remove from the site surplus excavated materials resulting from work. Surplus excavated materials include materials not suitable for use as backfill.
- M. Notify utility companies and state "one-call" system for verification of underground utilities before any excavation takes place.

1.4 WATERPROOFING

- A. Where work pierces waterproofing, including waterproof concrete, the method of installation shall be approved by the Architect prior to performing the work. Furnish necessary sleeves, caulking and flashing required to make openings absolutely watertight.

1.5 AIR PLENUMS

- A. Plenums which are used as part of an air distribution system as defined by NFPA , materials must be of the type rated for air plenum use. The Contractor shall be responsible to utilize the correct materials in ceiling space used for environmental air purposes.

1.6 ELECTRICAL CONNECTIONS AND PROTECTION

- A. Regardless of voltage, provide control wiring, interlock wiring, and equipment control wiring for the equipment provided under this division of the specifications.
- B. Furnish electrical disconnect switches, starters and combination starter disconnects required for equipment provided under this division of the specifications. Circuit breakers furnished shall be rated for motor protection.

- C. Power wiring not used for control functions, complete from power source to motor or equipment junction box, including power wiring through starters, shall be provided under Division 26.
- D. Coordinate to ensure that electrical devices furnished or provided are compatible with the electrical systems used.
- E. Confirm final location of electrical equipment to be installed in the vicinity of piping.

1.7 ACCESSIBILITY

- A. Coordinate to ensure the sufficiency of the size of shafts, and chases, and the adequacy of clearances in hung ceilings and other areas required for the proper installation of this work.
- B. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Locations in ceilings requiring access shall be coordinated with, but not limited to lights, curtain tracks, speakers, etc. Equipment requiring access shall include, but is not necessarily limited to, valves, traps, clean-outs, pumps, drain points, etc.
- C. Indicate the locations of access doors for each concealed valve, piece of equipment, components, or other device concealed behind finished construction and requiring service on the coordination drawings.

1.8 PAINTING

- A. Painting requirements of this section shall conform to Division 9 – Painting.
- B. Provide surface preparation, priming, and final coat application in strict accordance with manufacturer's recommendations.
- C. Provide field painting of systems, equipment and miscellaneous metals located outdoors. Application shall be in strict accordance with manufacturer's recommendations.
- D. Provide painting of plumbing piping and equipment exposed in mechanical equipment room and in occupied spaces. Plumbing items to be painted are as follows:
 - 1. Piping, pipe hangers, pipe insulation, and supports
 - 2. Equipment and supports.
 - 3. Tanks.
 - 4. Accessory items.

1.9 EQUIPMENT FOUNDATIONS, SUPPORTS, PIERS AND ATTACHMENTS

- A. Provide necessary foundations, auxiliary steel, supports, pads, bases and piers required for equipment specified in this division; submit drawings in accordance with Shop Drawing Submittal requirements prior to the purchase, fabrication or construction of same.
- B. Provide 4 inch thick concrete pads for rotating and floor-mounted equipment. Pads shall be extended 6 inches beyond machine base in each direction with top edge chamfered.

Anchor equipment pads to the floor in accordance with latest building codes seismic requirements.

- C. Construction of foundations, supports, and pads where mounted on the floor, shall be of the same materials and same quality of finish as the adjacent and surrounding floor material.
- D. Equipment shall be securely attached to the building structure in an approved manner. Attachments shall be of strong and durable nature and any attachments that are, in the opinion

of the Architect, deemed insufficient shall be replaced as directed, with no additional cost to the Owner.

1.10 CLEANING, PROTECTION AND

ADJUSTMENT A. Cleaning

- 1. General cleaning requirements are specified in Division 1.
- 2. Upon completion of the work, clean the exterior surface of equipment, accessories, and trim installed. Clean, polish, and leave equipment, accessories, and trim in first-class condition.

B. Protection of Surfaces

- 1. Protect surfaces from damage during the construction period.
- 2. Provide plywood or similar material under equipment or materials stored on floors or roofs. Provide protection in areas where construction may damage surfaces.
- 3. Surfaces damaged during the construction shall be repaired or replaced at the cost of the Contractor at fault. The method of repairing or replacing the surface shall be approved by the Owner and Architect

C. Protection of Services

- 1. Protect services from damage during the construction period.
- 2. Repair, replace and maintain utilities, facilities or services (underground, above ground, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction.
- 3. Services damaged during the construction shall be replaced at the cost of the Contractor at fault. The method used in repairing, replacing or maintaining the services shall be approved by the Owner and Architect

D. Protection of Equipment and Materials

- 1. Equipment and materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground and out of standing water by means of pallets or racks, and covered with tarpaulins.

2. Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and replacement if, in the opinion of the Architect or manufacturer the equipment has deteriorated or been damaged to the extent that its immediate use or performance is questionable, or that its normal life expectancy has been curtailed.
3. During the construction period, protect piping, fittings, valves, equipment, and associated appurtenances from damage and dirt. Each system of piping shall be flushed to remove grit, dirt, sand, and other foreign matter for as long a time as required to thoroughly clean the systems.

E. Adjustment

1. After the entire installation has been completed, make required adjustments to balancing valves, circulating systems, pressure reducing valves and similar devices until performance requirements are met.
2. Provide factory-lubricated bearings for equipment. Before initial startup of equipment, inspect and verify bearings for proper amounts of lubricant. If required, provide proper amounts of lubricant in accordance with manufacturer's recommendations.

1.11 SPECIAL TOOLS

- A. Provide the Owner's representative with two (2) sets of special tools required for operation and maintenance of equipment provided.

1.12 WELDING

A. General Requirements

1. This paragraph covers the welding of systems. Deviations from applicable codes, approved procedures and approved shop drawings shall not be permitted. Materials or components with welds made off site shall not be accepted if the welding does not conform to the requirements of this specification. Develop and qualify procedures for welding metals included in the work. Certification testing shall be performed by an approved independent testing laboratory. Bear costs of such testing.
2. Certified welders, previously certified by test, may be accepted for the work without re-certification provided that all of the following conditions are fulfilled:
 - a. Submit copies of welder certification test records in accordance with this Division and Division 1 requirements.
 - b. Testing was performed by an independent testing laboratory.
 - c. The welding procedures and welders are certified in accordance with the "ASME Boiler and Pressure Vessel Code," and base materials, filler materials, electrodes, equipment, and processes conform to the applicable requirements of this specification.
 - d. Certification has been within a one (1) year period from the start of the project.

3. Filler metals, electrodes, fluxes and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to assure safe handling.
4. Submit welding certificates for review. Each welder assigned to work covered by this specification shall be certified by performance tests using equipment, positions, procedures, base metals, and electrodes or bare filler wires.
5. Before assigning welders to the work, provide the architect with their names, together with certification that each individual is certified as specified. No welding work shall start prior to submissions. The certification shall state the type of welding and positions for which each is certified, the code and procedure under which each is certified, date certified, and the firm and individual certifying the certified tests.
6. Each welder shall be assigned an identifying number, letter, or symbol that shall be used to identify his welds. A list of the welders' names and symbol for each shall be submitted. To identify welds, either written records indicating the location of welds made by each welder shall be submitted, or each welder shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 3 foot intervals. Identification by die stamps or electric etchers shall be confined to the weld reinforcing crown, preferably in the finished crater.

1.13 DIELECTRIC FITTINGS

- A. Ferrous to non-ferrous pipe connections shall be made with threaded, soldered, plain, or welded end connections that match piping system material. Dielectric fittings shall prevent any electrolytic action between dissimilar materials.

1.14 PIPING CONNECTIONS

- A. Make pipe connections according to the following
 1. Provide unions in supply piping systems 4 inches and smaller:
 - a. Adjacent to each side of valve
 - b. At final connection to equipment
 2. Provide flanged connections for supply piping systems 4 ½ inches and larger:
 - a. Adjacent to each side of valve
 3. At final connection to equipment

1.15 EXPANSION JOINTS

- A. Provide expansion joints on piping passing through the building expansion joint. The joints shall be Rubber Expansion joints, heavy duty, double arc movement with single wide arch, reduced movement forces, Fabric and steel reinforced, Suitable for pressures up to 200 psi, sized according to applicable pipe sizes, installed per the Manufacturer's instructions.

1. Manufacturer and Model
 - a. Unaflex – Style 1000
 - b. Flexicraft Industries
 - c. Metraflex

1.16 SITE WATER SYSTEM FLOW TEST

1. Conduct a water supply flow test and provide flow test report certified by a professional engineer to the Architect/Engineer for review.

1.17 THIRD-PART TESTING AND CERTIFICATION

1. Provide Products and Materials requiring third-party testing and certification per IPC 2009.

PART 2 - PRODUCTS

2.1 PROTECTION OF ELECTRICAL EQUIPMENT

- A. Plan and arrange overhead piping to avoid dedicated electrical space that may include motors, controllers, switchboards, panel boards, or similar equipment.
 1. Dedicated electrical space is equal to the width and depth of the electrical components and extends from the floor to a height of 6 feet above the electrical components or to the structural ceiling, which ever is lower. No piping, leak detection apparatus, equipment, components or associated appurtenances foreign to the electrical installation shall be located in the dedicated electrical space.
 2. Dropped, suspended, or any other type of ceiling that does not add strength to the building structure can not be provided as a separation between dedicated electrical space for the installation of foreign components within the dedicated electrical space.
- B. Where the installation of foreign components occur above the dedicated electrical space (6 feet above the electrical systems), contractor shall provide a means of secondary containment to prevent damage to the electrical systems.
- C. Secondary containment shall consist of gutters as follows:
 1. Provide gutter of 16 ounce cold rolled copper or heavy galvanized steel, under every pipe.
 2. Each gutter shall be soldered and made watertight, properly suspended and carefully pitched to a convenient point for draining. Provide a 3/4 inch drain with valve as directed, to nearest floor drain or mop basin.
 3. In lieu of such separate gutters, a continuous protecting sheet of similar construction supported, braced, properly rimmed, pitched and drained, may be provided.

2.2 ACCESS DOORS

- A. Access doors shall be a minimum of 18 inch x 18 inch and manufactured as an integral unit, complete with all parts and ready for installation.
- B. Access doors and frames shall be of continuous welded steel construction, unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
- C. Frames shall be fabricated from 16-gauge steel.
 - 1. Fabricate frame with exposed flange nominal 1 inch wide around perimeter of frame for units installed in the following construction:
 - a. Exposed Masonry
 - 2. For gypsum drywall or veneer gypsum plaster, furnish perforated frames with drywall bead.
 - 3. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.
 - 4. For full-bed plaster applications, furnish frames with galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame
- D. Flush Panel Doors shall be fabricated from not less than 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175°. Finish with manufacturer's factory-applied prime paint.
 - 1. For fire-rated units, provide manufacturer's standard insulated flush panel/doors, with continuous piano hinge and self-closing mechanism.
- E. Locking devices shall be flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.
- F. Manufacturers:
 - 1. Bar-Co., Inc.
 - 2. J. L. Industries
 - 3. Karp Associates, Inc.
 - 4. Nystrom, Inc.

2.3 WELDING

- A. Welding materials shall comply with the "ASME Boiler and Pressure Vessel Code." Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a certified welder using qualified welding procedures.

2.4 DIELECTRIC FITTINGS

- A. Dielectric unions shall be factory – fabricated assemblies with a minimum working pressure as required to suit system pressures.

- B. Dielectric flanges shall be factory – fabricated, companion flange assemblies with a minimum working pressure as required to suit system pressures.
- C. Dielectric flange kits shall be field – fabricated with a minimum working pressure as required to suit system pressures. Kit shall include flanges, full face type phenolic gasket, phenolic bolt sleeves, phenolic washers, and steel backing washers.
- D. Dielectric couplings shall be galvanized steel with inert and noncorrosive, thermoplastic lining, threaded ends and a minimum working pressure as required to suit system pressures.
- E. Dielectric nipples shall be electroplated steel nipple with unert and noncorrosive, thermoplastic lining, plain, threaded, or grooved ends and a minimum working pressure as required to suit system pressures.
- F. Manufacturers
 - 1. Watts Industries
 - 2. Zurn Industries
 - 3. Sioux Chief Industries

PART 3 - EXECUTION

3.1 ACCESS DOORS

- A. Coordinate installation of access doors with the General Contractor. Locations of access shall be submitted and doors furnished in sufficient time to allow installation in the normal course of the work.

3.2 WELDING

- A. Perform welding in accordance with qualified procedures using certified welders. Welding shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions. Welding of hangers, supports, and plates to structural members shall conform to AWS specifications.
- B. Field bevels and shop bevels shall be by mechanical means or by flame cutting. Where beveling is by flame cutting, thoroughly clean surfaces of scale and oxidation just prior to welding. Beveling shall conform to ANSI B31.1 and AWS B3.0.
- C. Replace and re-inspect defective welds. Repairing defective welds by adding weld material over the defect or by peening shall not be permitted. Welders responsible for defective welds must be re-certified.
- D. Store electrodes in a dry heated area, keep free of moisture and dampness during fabrication operations. Discard electrodes that have lost part of their coating.

END OF SECTION 220500

SECTION 220519 - PLUMBING PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 PRESSURE GAUGES

- A. Provide pressure gauges at suction and discharge connections to pumps, at domestic water heaters, and as indicated on the drawings.

1.3 THERMOMETERS

- A. Provide thermometers at each domestic water heater and as indicated on the drawings.

1.4 SPECIAL TOOLS

- A. Provide the Owner's representative with two (2) sets of special tools required for operation and maintenance of equipment provided.

1.5 SUMMARY

- A. This section includes the following:
 - 1. Pressure Gauges
 - 2. Thermometers
 - 3. Special Tools

PART 2 - PRODUCTS

2.1 GENERAL

- A. All components, fittings, equipment, specialties, etc., shall meet the component pressure rating listed.

2.2 PRESSURE GAUGES

- A. Pressure gauges shall have 4-1/2 inch diameter aluminum cases, no back flange, and removable chrome slip ring. Finish shall be black enamel. Gauge dial shall be white coated with black figures, gradations, and micro adjustable. High-grade shutoff cocks shall be provided between gauge and piping to permit gauge removal while system is under pressure. Gauges shall be capable of reading to approximately twice the working pressure. Accuracy: +1/2 of 1 percent.
- B. Manufacturer and Model
 - 1. Weiss Instruments Series UG-1 Type AN
 - 2. Ashcroft Type 1279

3. Trerice No. 500X Series

2.3 DIGITAL VARIABLE ANGLE SOLAR THERMOMETERS

- A. All thermometers shall be digital type within 1% accuracy. Unit shall be solar powered. Digital Thermometers shall be adjustable angle type, with 6 inch stem and 2-1/2 inch brass extension neck separable socket. .
- B. Manufacturers:
 - 1. Weiss
 - 2. Weksler

PART 3 - EXECUTION

3.1 PRESSURE GAUGES

- A. Gauges shall be installed such that they are easily read from the normal observation point.

3.2 THERMOMETERS

- A. Install thermometers in oversized pipe tee and nipple.
- B. Thermometers shall be installed such that they are easily read from a normal observation point.

END OF SECTION

SECTION 220523 - PLUMBING VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL

- A. Provide manual valves as shown on the drawings, specified herein, and as required for proper control and maintenance of plumbing systems and equipment.
- B. Valves shall be the product of one manufacturer except for special applications.
- C. Valves shall be of same minimum working pressure and materials as specified for fittings of the system in which they are installed. Regardless of service, valves shall be designed for a minimum 125 psi steam working pressure.
- D. Install valves in accessible locations.
- E. Valves for equipment shutoff shall be size of pipe indicated on the drawings before reducing to equipment size.
- F. Valves in mechanical equipment rooms above 7 feet shall have chain-wheel operators.

1.3 SUMMARY

- A. This section includes the following:
 - 1. Butterfly valves
 - 2. Ball Valves
 - 3. Check Valves
 - 4. Calibrated Balancing Valves

PART 2 - PRODUCTS

2.1 BUTTERFLY VALVES (Domestic Water)

- A. 2-1/2 inches and larger shall be: lug type with carbon steel body, 316 stainless steel disc, and gear operated hand wheel. Liner shall be 317 stainless steel with PTFE woven fabric. Class 150 body, 285 psi bubble tight shut-off in either direction.
- B. Manufacturer and Model:
 - 1. DeZurik Unit. – Model HP series Class 150
 - 2. Bray International, Inc. – Model 40 series Class 150
 - 3. Cooper Cameron Model WKM

2.2 BALL VALVES (Potable Water)

- A. Ball valves 2 inches and smaller shall be: 600 psi non-shock cold water, ASTM B124, C37700 two piece brass forging body and end piece, brass alloy blow out proof stem, free floating chromium plated brass ball, TFE seats, full port opening and extension handle.
- B. Manufacturer and Model: (Soldered End Connections)
 - 1. Crane Valve. – Model 9323-EX
 - 2. Hammond Valve. – Model 8911-XH
 - 3. Watts Industries, Inc. – Model FBVS-3C-XH
 - 4. Apollo Valve – Model 77C-200-04

2.3 CHECK VALVES (Pump discharge)

- A. Check valves shall be non-slam, silent operating, wafer type, cast iron body, replaceable lapped bronze seat, lapped and balanced twin bronze flappers loaded with stainless steel torsion spring, and stainless steel

trim. B. Manufacturer and

Model:

- 1. Hammond Valve. – Model IR9253
- 2. Milwaukee Valve. – Model 1400
- 3. Watts Industries, Inc. – Model ICV-125

2.4 CHECK VALVES

- A. Check valves 2 inches and smaller shall be: 600 psi non-shock cold water, bronze body swing check valves with renewable bronze disc.

B. Manufacturer and Model: (Threaded End Connections)

- 1. Hammond Valve. – Model IB949
- 2. Milwaukee Valve. – Model 507
- 3. Watts Industries, Inc – Model B5030

2.5 CALIBRATED BALANCING VALVE (Potable water)

- A. Calibrated water balancing valve shall be bronze body / brass ball. Valve shall have differential pressure read out ports with check valve, tapped drain / purge port, memory stop, and calibrated nameplate.

B. Manufacturer and Model

- 1. Bell and Gossett Circuit Setter Plus
- 2. Watts – Model CSM-61

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide shut-off valves at each plumbing fixture and / or equipment requiring plumbing service regardless of whether shown on the drawings.
- B. Install valves so that the tops of the valve stems are above the horizontal.
- C. Valves shall be provided with stem extensions when installed on insulated piping.

3.2 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523

SECTION 220529 - PLUMBING HANGERS, SUPPORTS, AND SLEEVES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 HANGERS AND SUPPORTS

- A. Provide hangers and supports as shown on the drawings and as specified herein.

1.3 SLEEVES

- A. Provide sleeves as shown on drawings and as specified herein.

1.4 ESCUTCHEONS

- A. Provide escutcheons as shown on drawings and as specified herein.

1.5 SUMMARY

- A. This section includes the following:
 - 1. Hangers and supports
 - 2. Sleeves
 - 3. Escutcheons
 - 4. Flashing

PART 2 – PRODUCTS

2.1 HANGERS AND SUPPORTS

A. General

1. Hanger design shall conform to Federal Specification WWH-171; Manufacturers Standardization Society ANSI / MSS–SP–58; and installed in accordance with ANSI / MSS–SP-69.
2. Specified bracket clamp and rod sizes are minimum sizes. Support and hanger design shall include a safety factor of 5.
3. Field fabricated trapeze hangers with suspension rods having double nuts and securely attached to the construction may be provided instead of separate clevis hangers.
4. Plastic-coated hangers and clamps shall be provided for uninsulated brass or copper pipe, unless shields are provided between hangers or clamps.
5. Provide steel required for support of pipes other than steel shown on structural drawings.
6. Chain straps, perforated bars, wire hangers or expansion shields are not permitted.
7. Inserts for piping shall be of a type which shall not interfere with structural reinforcing and

which shall not displace excessive amounts of concrete.

8. Piping located near floors that can be supported from floor or walls shall be provided with approved floor stands, wall brackets, roller supports, masonry piers or similar items.
9. Resilient hangers and isolation devices shall be provided on piping connected to rotating equipment, including pumps, and on other piping which may vibrate and create audible noise for hangers within 15 feet of the rotating piece of equipment.
10. Rigid hangers for horizontal piping shall provide a means of vertical adjustment after erection.
11. Vertical piping shall utilize riser clamps specifically designed for piping.

B. Manufacturers and Model

<u>Hanger Type</u>	<u>PHD</u>	<u>Erico</u>	<u>B-Line</u>	<u>Anvil Internation</u>
Adjustable center load beam clamp	630	360	B3054	218
Standard clevis hanger	450	400	B3100	260
Insulated pipe clevis hanger	430	403	B3108	300
Copper tubing clevis hanger	440	402	B3104CT	CT-65
Standard riser clamp	550	510	B3373	261
Copper riser clamp	552	511	B3373CT	CT-121
Double bolt pipe clamp	525	450	B3140	295
Underground pipe clamp	580	---	B3132	---
Straight J-hook	810	458	B3191	---
Adjustable pipe saddle support with U-bolt	876	724	B3092	259
Standard U-bolt	90	150	B3188	137
Welded beam attachment	900	320	B3083	66
Welded steel bracket, heavy duty	860	353	B3067	199
Welded steel bracket, light duty	855	352	B3066	195
Concrete insert	950	355	B2505	282
180 degree shield	170	125	B3151	167

C. Hanger Rod Schedules

Pipe Size	Minimum Rod Size
Up to 2 inches	3/8 inch diameter
2-1/2 inches to 4 inches	1/2 inch diameter
4 inches to 5 inches	5/8 inch diameter
6 inches	3/4 inch diameter
8 inches to 12 inches	7/8 inch diameter

14 inches to 18 inches	1 inch diameter
20 inches to 30 inches	1 1/2 inch diameter

D. Fasteners and Anchors

1. Cast-In-Place Bolts
 - a. Anchors, Bolts, Nuts, and Washers: Bolts and studs, nuts, and washers shall conform to ASTM A307, Grade A, and ASTM A449, ASTM A563, and ASTM F436, as applicable.
 - b. Hot-dip galvanized bolts and studs including associated nuts and washers in accordance with ASTM A153.
2. Drilled-In Anchors
 - a. Wedge Anchors: Wedge type, torque-controlled, with impact section to prevent thread damage complete with required nuts and washers.
 - 1) Provide anchors with length identification markings conforming to ICC ES AC01 or ICC ES AC193.
 - 2) Interior Use: Provide carbon steel anchors with zinc plating in accordance with ASTM B633.
 - 3) Exterior Use: Provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
 - 4) Manufacturer
 - a. Hilti
 - b. Fastenal
 - b. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions.
 - 1) Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel threaded rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, or carbon steel HIT TZ rods conforming to ASTM A510 with chemical composition of AISI 1038.
 - 2) Exterior Use: Provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified.
 - 3) Reinforcing dowels shall be A615 Grade 60.

- 4) Manufacturer
 - a. Hilti
 - b. Fastenal
- c. Capsule Anchors: Threaded steel rod, inserts and reinforcing dowels with 45 degree chisel point, complete with nuts, washers, glass or foil capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, and manufacturer's installation instructions.
 - 1) Interior Use: Unless otherwise indicated on the Drawings, provide chisel-pointed carbon steel rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633.
 - 2) Exterior Use: As indicated on the Drawings, provide chisel-pointed stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified.
 - 3) Reinforcing dowels shall be A615 Grade 60, with 45-degree chisel-points at embedded end.
 - 4) Manufacturer
 - a. Hilti
 - b. Fastenal

2.2 SLEEVES

- A. Provide sleeves for piping passing through walls, floors, ceilings, roofs, equipment, structural members, and other building parts. Sleeves shall be securely fastened to the assembly penetrated.
 1. Through penetration of fire-resistance-rated walls
 - a. Annular space between sleeves and pipes shall be protected by an approved penetration fire stop system installed and tested in accordance with ASTM E814, with a minimum positive pressure differential of 0.01 inch of water and shall have an F rating of not less than the required fire resistance rating of the wall penetration.
 - b. Sealant in one-hour and two-hour walls shall be UL listed and installed in accordance with manufacturer's recommendations.
 - c. Manufacturer (Sealant)
 - 1) Dow Corning
 - 2) Nelson
 2. Through penetration of fire-resistance-rated floor and roof assemblies

- a. Annular space between sleeves and pipes shall be protected by an approved through-penetration fire stop system installed and tested in accordance with ASTN E814, with a minimum positive pressure differential of 0.01 inch of water. The system shall have an F rating and a T rating of not less than one hour but not less than the required rating of the floor penetration
 - b. Sealant in one-hour and two-hour floors shall UL listed and installed in accordance with manufacturer's recommendations.
 - c. Manufacturer (Sealant)
 - 1) Dow Corning
 - 2) Nelson
3. Through penetrations of nonfire-resistance-rated walls
- a. Annular space between sleeves and pipes in nonfire-resistance-rated assemblies shall be filled or tightly caulked in an approved manor.
 - b. Sealant for general purpose use and for Kitchen, Food Preparation, and Dining areas shall be provided in accordance with manufacturer's recommendations.
 - c. Manufacturer (Sealant)
 - 1) Dow Corning
 - 2) Nelson
- B. Pipes through or under footing or foundation walls shall be provided with a pipe sleeve built into the foundation wall. The pipe sleeve shall be two pipe sizes greater than the pipe passing through the wall. A link seal should be used to complete the assembly. Refer the mfrs literature for installation requirements.
- C. Piping shall be installed to prevent strains and stress that exceed the structural strength of the pipe. Provisions shall be made to protect piping from damage resulting from expansion, contraction, and structural settlement.
- D. Where piping is provided through holes, notches in studs, joists, rafters, or other similar members and is less than 1.5 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 0.062 inch thick steel and shall cover the area of the pipe that is closer than 1.5 inches from edge.
- E. Schedule of Sleeve Materials

Sleeve Type Sleeve Material

- 1 18 gauge galvanized steel
- 2 Std. weight galvanized steel pipe
- 3 Std. weight galvanized steel pipe with a continuously welded water stop of 1/4 inch steel plate extending a minimum of 2 inches from the outside of the sleeve.

- 4 Std. weight galvanized steel pipe with flashing clamp device welded to pipe sleeve or watertight sleeves.

2.3 ESCUTCHEON PLATES

1. Schedule of Escutcheon Plate Materials

<u>Location</u>	<u>Escutcheon Plate Material</u>
Finished spaces	Anodized aluminum or chrome-plated brass
Unfinished spaces	Plain brass, cast iron or aluminum

PART 3 – EXECUTION

3.1 GENERAL

- A. Provide provision for expansion and contraction, on the hangers and through sleeves to prevent undue stress or strain on piping, building anchor points, and connected equipment.
- B. Piping passing through roof construction shall be arranged to provide a minimum of 12 inch clearance from walls or other obstructions so as to permit proper flashing. Set pipe flashing fittings at a suitable level above the roof to permit proper termination of flashing.

3.2 PIPE HANGERS AND SUPPORTS

A. Pipe Hanger Support Schedule

<u>Building Construction</u>	<u>Pipe Support Method</u>
Poured concrete floor slabs	Galvanized steel inserts, and/or fish plates of sufficient area to support twice the calculated dead load
Building structural steel	Beam attachments and similar devices
Precast concrete floor slabs	Fish plates of sufficient area to support twice the calculated dead load and approve type specialty hanger accessories manufactured for the specific purpose of attaching to precast floors
Metal deck floor slabs with concrete fill	Galvanized steel inserts and/or fish plates of sufficient area to support twice the calculated dead load, and approved type specialty hanger accessories manufactured for the specific purpose of attaching to metal deck floors
Concrete slabs where piping revisions are required and approved after slabs are poured or existing slabs	"Phillips" or "Hilti" expansion bolts and shields for piping 4 inches and smaller, with main supports welded to structural steel at maximum 20 feet on center 4 inch x 4 inch x 3/8 inch thick clip knee angles with 3/4 inch expansion bolt in shear (horizontal) and supporting rod at 90° from anchor bolt for piping greater than 4 inches, attached to concrete beams or columns

Concrete floor slabs on grade with ground water condition Drainage, waste and vent piping to be encased in slab construction

B. Pipe Support Spacing

<u>Piping Material</u>	<u>Maximum Horizontal Spacing</u>	<u>Maximum Vertical Spacing</u>
Cast Iron Pipe	5 Feet	15 Feet
Copper or copper-alloy tubing	12 Feet	10 Feet
Copper or copper-alloy tubing, 1-1/4 inch diameter and smaller	6 Feet	10 Feet
Copper or copper-alloy tubing, 1-1/2 inch diameter and larger	10 Feet	10 Feet
Steel Pipe		
1/2 inch	6 Feet	6 Feet
3/4 inch and 1 inch	8 Feet	8 Feet
1-1/4 inch and larger	10 Feet	10 Feet

1. Provide hangers no more than 12 inches from direction changes.
2. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for pipe sizes 4 inches and larger.
3. Drainage piping shall be anchored to prevent axial movement.
 - a. For pipe sizes greater than 4 inches, restraints shall be provided for drainage piping at all changes in direction and at changes in diameter greater than two pipe sizes. Braces, blocks, rodding and other suitable methods as specified by the coupling manufacturer shall be utilized.

C. Fasteners and Anchors

1. Cast-In-Place Bolts: Use templates to locate bolts accurately and securely in form work.
2. Drilled-In Anchors:
 - a. Holes shall be drilled perpendicular to the concrete surface.
 - b. Cored Holes: Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer.
 - c. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling.
 - d. Base Material Strength: Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - e. Perform anchor installation in accordance with manufacturer instructions.
3. Wedge Anchors:

- a. Protect threads from damage during anchor installation.
 - b. Heavy-duty sleeve anchors shall be provided with sleeve fully engaged in part to be fastened.
 - c. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - d. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut.
 - e. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced.
4. Cartridge Injection Adhesive Anchors:
- a. Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive.
 - b. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - c. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.
5. Capsule Anchors:
- a. Perform drilling and setting operations in accordance with manufacturer instructions.
 - b. Clean all holes to remove loose material and drilling dust prior to installation of adhesive.
 - c. Remove water from drilled holes in such a manner as to achieve a surface dry condition.
 - d. Capsule anchors shall be installed with equipment conforming to manufacturer recommendations.
 - e. Do not disturb or load anchors before manufacturer specified cure time has elapsed.
6. Provide in accordance with manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

3.3 PIPE SLEEVES

- A. Install Link-Seal in the penetration for water tight installation.
- B. Schedule of Sleeve Lengths

<u>Location</u>	<u>Sleeve Length</u>
Floors	Equal to depth of floor construction and installed flush with finished floor construction.
Roofs	Equal to depth of roof construction including insulation.

Walls Equal to depth of construction and terminated flush with finished surfaces.

C. Schedule of Sleeve Caulking and Packing

Caulking/ Packing Type	Caulking/Packing Requirements
A	Space between pipe or pipe covering and sleeve shall be caulked with an incombustible permanently plastic waterproof, non-staining compound leaving a smooth, finished appearance.
B	Verminproofing - space between pipe and sleeve shall be packed with insulation consisting of sections of foam glass equal in length to length of sleeve, caulked at both ends with sealant according to manufacturer's recommendations. Verminproofing for pipes with insulation shall be minimum 1 inch thick sections of foam glass as long as sleeves with space between foam glass and sleeve packed with industrial felt or fiberglass caulked at both ends with sealant and capped with a metal collar that is securely fastened to the adjoining structure.

D. Schedule of Sleeve Applications

Location	Sleeve Type Thru Fire Rated Construction	Sleeve Type Thru Non-Fire Rated Construction	Sleeve Caulking and Packing Type
Membrane water-proof floor, roof and wall construction	4	4	B
Non-membrane waterproof floor, roof and wall construction where flashing is required	4	4	B
Interior walls and floors	2	2	B
Exterior walls	---	3	B
Cellular metal deck floors	2	2	A
Precast concrete floor with poured concrete topping	--	1	A

3.4 PIPE FLASHING

- A. Pipe passing through roof construction shall be arranged to provide a minimum of 12 inches clearance from walls or other obstructions so as to permit proper flashing.

END OF SECTION 220529

SECTION 220533 - HEAT TRACE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 HEAT TRACE

- A. Provide heat trace as shown on drawings and as specified herein.

1.3 SUMMARY

- A. This section includes the following:
 - 1. Heat trace

PART 2 – PRODUCTS

2.1 HEAT TRACING

- A. Heat tracing shall be U.L. listed and provided with a thermostatically controlled monitoring control panel and ground fault protection for each individual heat tracing circuit.
- B. The heat tracing shall be suitable for operation at 277 volts. Coordinate with electrical specifications.
- C. The heat tracing shall be capable of maintaining a pipe temperature of 40 deg. F with an ambient temperature is -20 deg. F.
- D. Heat tracing shall consist of low heat density, parallel circuited heater strip comprised of two 16 AWG or larger bus bars and a continuous inner core of self-regulating polymer material. Insulation for core shall comprise of an inner polyolefin jacket and a tinned copper braid covered with polyolefin fluoropolymer outer jacket. Heat trace conductor shall be capable of being cut to desired lengths in the field.
- E. Heat tracing for sanitary // storm //. shall be as follows:
 - 1. Sanitary – Cast iron
 - 2. Storm – Cast Iron
 - 3. Domestic Hot water – Copper
 - 4. Hot Water Return - Copper
- F. Provide schematic electrical wiring drawings, indicating each heat trace circuit, ambient thermostat and pipeline thermostat controls, normal circuit current draw and in rush circuit current draw at zero degrees F. All heat trace circuits shall be identified with their circuit number, heat trace size and length.
- G. Provide heat trace, tape, power connection, splice, end seal, tee kits, wiring, and associated appurtenances for a complete operational system.

- H. Provide a separate junction box feed for each continuous length of heat tracing, with the wiring between the junction box and control panel. Provide wiring in weatherproof rigid conduits with weatherproof junction boxes.
- I. When connecting to a 3-phase electrical power source, the Contractor shall ensure a closely balanced electrical current loading on all three phases.
- J. Provide monitoring and control panel in a stainless steel with NEMA 4 enclosures.
- K. Monitoring and control panel shall be provided with:
 - 1. Ground fault circuit interrupting circuit breaker for each circuit.
 - 2. Thermostat and contactor to energize the circuits at a predetermined temperature.
 - 3. LED panel display of program mode, actual temperature, control temperature, power on, contactor closed, circuits normal/tripped, alarm conditions de-energized line/contactor failure/breaker tripped), pre-wired terminal blocks, and programming parameters.
 - 4. Contacts in the control panel for the building automation system to monitor circuits alarm and status conditions.
- A. Manufacturer and Model
 - 1. Raychem 5XL
 - 2. Nelson

PART 3 – EXECUTION

3.1 HEAT TRACING

- A. Install heat tracing in accordance with manufacturer's recommendations.

3.2 HOT WATER TEMPERATURE MAINTENANCE

A. Installation

- 1. The system shall be installed according to the drawings and the manufacturer's instructions.
- 2. The installer shall be responsible for providing a functional system, installed in accordance with applicable national and local requirements.
- 3. Each circuit shall be protected with a 30 mA ground-fault protection device.

B. Testing

- 1. Measure the heater circuit continuity and the insulation resistance between the braid and the bus wires with a 2500 Vdc meg ohm meter (megger).
- 2. The tests should be performed after the pipe insulation has been installed and prior to the installation of wall or ceiling panels, and shall be witnessed by the Construction Manager and the manufacturer or the manufacturer's representative.
- 3. The heater circuit shall be continuous and megger readings shall be at least 1000 meg ohm regardless of the heater length. Circuits yielding unacceptable readings must be repaired or replaced.

- C. Submit records of the test data to the Construction Manager. Self-regulating heating cables and components to have a limited 10-year warranty extension from the date of installation if a

properly completed online warranty form is completed within 30 days from the date of installation.

END OF SECTION 220533

SECTION 220548 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Open-spring isolators.
4. Pipe-riser resilient supports.
5. Resilient pipe guides.
6. Elastomeric hangers.
7. Spring hangers.
8. Snubbers.
9. Mechanical anchor bolts.
10. Adhesive anchor bolts.

- B. Related Requirements:

1. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.

- D. Field quality-control reports.
- 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Products: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
3. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
4. Size: Factory or field cut to match requirements of supported equipment.
5. Pad Material: Oil and water resistant with elastomeric properties.
6. Surface Pattern: Smooth pattern.
7. Infused nonwoven cotton or synthetic fibers.
8. Load-bearing metal plates adhered to pads.
9. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Products: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Ace Mountings Co., Inc.

- b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
3. Mounting Plates:
- a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
4. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Products: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
8. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.4 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig (3.45 MPa) on isolation material providing equal isolation in all directions.

2.5 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) thick neoprene.
1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.6 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 2. Products: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Mountings & Controls, Inc.
 3. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 4. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.7 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 2. Products: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Kinetics Noise Control, Inc.

- d. Mason Industries, Inc.
 - e. Vibration Eliminator Co., Inc.
 - f. Vibration Isolation.
 - g. Vibration Mountings & Controls, Inc.
3. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 10. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.8 SNUBBERS

- A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
- B. Products: Subject to compliance with requirements, provide comparable product by one of the following:
 1. Kinetics Noise Control, Inc.
 2. Mason Industries, Inc.
 3. Vibration Mountings & Controls, Inc.
- C. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

2.9 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Products: Subject to compliance with requirements, provide comparable product by one of the following:
 1. Cooper B-Line, Inc.

2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

- C. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.10 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Products: Subject to compliance with requirements, provide comparable product by one of the following:
1. Hilti, Inc.
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
- C. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03.
- B. Installation of vibration isolators must not cause any change of position of equipment or piping resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- H. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator deflection.
 7. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PIPING, VALVES AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes the following:
 - 1. Pipe identification – Interior
 - 2. Pipe identification – Exterior
 - 3. Pipe identification – Below grade
 - 4. Valve tags
 - 5. Valve charts
 - 6. Equipment name plates
 - 7. Ceiling markers for concealed equipment, valves, and devices

PART 2 - PRODUCTS

2.1 PIPE IDENTIFICATION

A. Interior

- 1. Pipe bands indicating contents and flow direction shall be flexible vinyl film with acrylic pressure sensitive adhesive suitable for pipe surface temperatures of -40 °F to 220 °F.
- 2. Manufacturer and Model
 - a. Seton - Opticode
 - b. W.H. Brady - B-350 Perma-Code
 - c. Bunting - Identiflow

B. Exterior

- 1. Pipe bands indicating contents and flow direction shall be snap-on markers consisting of a surface-printed and overcoat-protected vinyl base material suitable for pipe surface temperatures from -40 °F to 150 °F.
- 2. Manufacturer and Model
 - a. Seton - Weather-Code Style AA
 - b. W.H. Brady - B-915 Brady Snap-On
 - c. Bunting

C. Below Grade

- 1. Metallic Pipe - Underground metallic pipe shall be identified by underground warning

tape. Tape shall be 0.004 inch thick, 6 inch wide polyethylene tape, color coded, with continuous message stating "Caution" and stating which type of pipe is buried.

2. Nonmetallic Pipe - Underground nonmetallic pipe shall be identified by underground metallic warning tape. Tape shall be 0.004 inch thick, 6 inch wide polyethylene tape with metallic core, color coded, with continuous message stating "Caution" and stating the type of pipe buried.

- D. Pipe marking shall comply with ANSI A13.1 Scheme for the Identification of Pipe Systems. Markers shall be in compliance with respect to:

1. Marker length
2. Background color
3. Letter color
4. Letter size

2.2 VALVE TAGS

- A. Brass with stamped numbers and letters (black-filled), 1-1/2 inch square with 1/2 inch numbers and 1/4 inch letters.

- B. Example for identifying letter for various systems shall be as follows:

1. Cold Water = CW
2. Hot Water = HW
3. Hot Water Return = HWR
4. Sanitary = SAN
5. Vent = V
6. Storm = ST

- C. Fastening shall be by brass "S" hooks, brass jack chains, or brass ball chains.

- D. Manufacturer and Model

1. Seton - Tag 2960-25
2. W.H. Brady
3. EMED Company
4. Bunting

2.3 VALVE CHARTS

- A. 8-1/2 inch by 11 inch (minimum or of sufficient size), wood or aluminum frames with Plexiglas covers. Include valve numbers, sizes, functions, and locations. Coordinate location with Owner. Chart shall have key plan denoting approximate valve location.

2.4 EQUIPMENT NAMEPLATES

- A. Heavy gauge (.025) aluminum with four mounting holes. Coloring in background, lettering, and pads in aluminum.

2.5 CEILING MARKERS FOR CONCEALED EQUIPMENT, VALVES, AND DEVICES

- A. Install color-coded ceiling markers on ceiling at concealed valve locations. Markers shall be a minimum of 7/8 inch diameter, and shall include engraving to indicate service.
- B. Manufacturer and Model
 - 1. Seton – Style ECM
 - 2. Brady – Style ECM
 - 3. EMED Company – Style ECM
 - 4. Bunting – Style ECM

PART 3 - EXECUTION

3.1 PIPE IDENTIFICATION

- A. Pipe identification shall be as follows:
 - 1. Piping shall have direction of flow arrows matching the legend and background colors adjacent to each marker and at branches.
 - 2. Pipe identification shall be placed on piping at 20 foot maximum intervals. In addition, wherever a pipe passes through a wall, floor, or ceiling, it should be identified on each side of the wall, floor, or ceiling.
 - 3. Where pipe insulation or pipe is to be painted, it should be painted to match the background color of its contents.
- B. Colors for pipe marking systems shall be in accordance with ANSI standards.
- C. Underground piping shall be identified with identification tape continuously while below grade.
 - 1. Depth of tape shall be 12 inches below grade for piping buried up to 30 inches deep, and 18 to 24 inches above pipe for depths below 30 inches deep.

3.2 VALVE IDENTIFICATION

- A. Provide identification tags for valves including control valves shutoff valves serving individual fixtures and equipment shall not be tagged.
- B. Valves shall have brass tags indicating system and valve number.
- C. Provide valve charts in an approved location secured to wall.
- D. Include a copy of the valve chart in each operation and maintenance manual.
- E. All valves located above ceilings shall be marked on the ceiling with valve identification pins.

END OF SECTION 220553

SECTION 220593 – TESTING, ADJUSTING, AND BALANCING

GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE

- A. Provide water systems balancing and testing by an approved member of a Certified Water Testing, Adjusting, and Balancing agency. The balancers must submit to the Architect a resume of experience, a sample of the forms to be used for the final report, and an inventory of the instruments to be used. Types, serial numbers and dates of last calibration of instruments used shall be listed in final balance reports.

1.3 WARRANTY

- A. Provide a guarantee on Testing and Balancing forms stating that testing and balancing will assist in completing requirements of the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified Testing and Balancing firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

1.4 SUMMARY

- A. This section includes the following:
 - 1. Examination
 - 2. General requirements for testing and balancing
 - 3. Tolerances
 - 4. Final Report.
 - 5. Final Inspection
 - 6. Additional Adjustment.

PRODUCTS (Not Used)

EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper testing and balancing of systems and equipment.
- B. It shall be the Testing and Balancing firm's responsibility to review the drawings and to notify the Engineer if additional valves, test plugs, components, and associated appurtenances are

required to properly balance the various systems prior to the installation of those systems. If the Testing and Balancing firm reviews the drawings and does not notify the Engineer that additional valves, test plugs, components, and associated appurtenances are required, then the Testing and Balancing firm shall be responsible to provide additional components, and associated appurtenances as required to properly balance the various systems at no additional cost to the Owner.

- C. Examine approved submittal data of systems and equipment.
- D. Examine system and equipment installations to verify that they are complete. Systems shall be cleaned, pressure tests completed and approved, and in continuous operation before balancing begins. Minimum continuous operation shall be 24 hours.
- E. Report deficiencies discovered before and during performance of testing and balancing procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 GENERAL REQUIREMENTS FOR TESTING AND BALANCING

- A. Provide complete testing and balancing of each and every water system and equipment that requires testing and balancing.
- B. Cut insulation, pipes, and associated appurtenances for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed.
- C. Neatly mark equipment and balancing device settings with paint or other suitable, permanent identification material, including valve position indicators, and similar controls and devices, to show final settings.
- D. Coordinate with the General Contractor to ensure proper balancing above inaccessible ceilings before the ceilings are completed.
- E. Final tests and adjustments necessary to demonstrate compliance with specified performance requirements for major items of equipment shall be directly supervised by the manufacturer's representatives.
- F. The Architect shall be notified in writing of the date and time of final balancing and testing activities. Notification must be received at least 48 hours in advance so that the Architect can be present if he so wishes.

3.3 TOLERANCES

- A. Set water flow rates within the following tolerances:
 - 1. Hot Water Return Flow Rate: Minus 5 to plus 5 percent of design values.

3.4 FINAL REPORT

- A. The Contractor shall obtain copies of the final Water Flow Balance and Test Reports from the

balancing agency. Submit same to the Architect in accordance with the shop drawing submittal requirements for the Architect's evaluation and approval.

- B. The report shall be a typewritten or computer generated printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- C. Include a certification sheet in front of binder signed and sealed by a Registered Professional Engineer.
- D. Include a list of instruments used for procedures, their serial numbers, and proof of calibration.

3.5 FINAL INSPECTION

- A. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by the Architect.
- B. Testing and Balancing firm test and balance engineer shall conduct the inspection in the presence of the Architect.
- C. The Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to 10 percent of the total measurements recorded.
- D. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- E. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- F. Testing and Balancing firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
- G. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another Testing and Balancing firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment to the HVAC Contract.

3.6 ADDITIONAL ADJUSTMENT

- A. Provide an additional 25 hours for balancing after occupancy for additional adjustment.

END OF SECTION 220593

SECTION 220719 - PLUMBING PIPE AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL

- A. Insulation shall have composite fire and smoke hazard ratings (including insulation, jacket or facing, PVC covers, and adhesives), as tested by ASTM E84, NFPA 255 or UL 723 procedures, not exceeding a flame spread rating of 25 and smoke developed rating of 50.
- B. Piping tests shall be completed before insulation proceeds.
- C. Asbestos shall not be used in the manufacture of or contained in any part of the insulation.

1.3 INSULATION

- A. Piping systems, including flanges, fittings, valves, expansion joints, drains and appurtenances shall be insulated as specified herein.
- B. Piping subject to freezing shall be insulated with a minimum of 2 inches insulation.

1.4 ADHESIVES AND COATINGS

- A. Provide adhesives and coating as specified herein.

1.5 SUMMARY

- A. This section includes the following:
 - 1. Domestic cold water piping insulation
 - 2. Domestic hot water piping insulation
 - 3. Domestic hot water return system piping insulation
 - 4. Trap primer water piping insulation
 - 5. Storm water piping insulation
 - 6. Emergency storm drainage piping insulation
 - 7. Horizontal sanitary / storm piping insulation associated with HVAC condensate
 - 8. Water booster pump discharge piping insulation
 - 9. Adhesives and coatings

PART 2 - PRODUCTS

2.1 PIPING SYSTEM INSULATION SCHEDULE

<u>Piping System</u>	<u>Insulation Type</u>	<u>Minimum Insulation Thickness</u>	<u>Notes</u>
Domestic cold water mains, risers, and branch piping	P-1	1 inch	
Domestic hot water mains, risers and branch piping	P-1	1 inch for piping 2 inches and smaller; 1-1/2 inch for pipes larger than 2 inches	
Domestic hot water circulation mains, risers and branch piping	P-1	1 inch for piping 2 inches and smaller; 1-1/2 inch for pipes larger than 2 inches	
Trap primer water piping	P-1	1 inch	
Storm piping and drain bodies	P-1	1 inch	Insulation shall be provided from main building risers up to and including drain bodies
Emergency storm mains, risers, branch piping and drain bodies	P-1	1 inch	Insulation shall be provided from main building risers up to and including drain bodies
Sanitary piping and drain bodies utilized for HVAC condensate drainage	P-1	1 inch	Insulation shall be provided from main building risers up to and including drain bodies
Storm piping and drain bodies utilized for HVAC condensate drainage	P-1	1 inch	Insulation shall be provided from main building risers up to and including drain bodies.
Water booster pump discharge piping	P-1	1 inch	

2.2 TYPE P-1 GLASS FIBER

- A. Insulation, including fiberglass fitting inserts, shall be glass fiber with a maximum K factor of .24 at 75°F mean temperature with factory applied all-service jacket with self-sealing lip. Exposed

pipe insulation material must be the one piece type. Sectional type may be used for concealed piping.

- B. Seal butt joints with 3 inch wide butt stripe adhered neatly in place.
- C. Fittings and valves for all piping shall be insulated with preformed fiberglass inserts of the same density as the pipe insulation and finished with a PVC fitting cover. Provide one fiberglass insert per fitting or valve for each 1 inch of piping insulation specified. Field cut or loose blanket insulation is not acceptable.
- D. Exposed piping shall be finished with a factory attached all-service jacket, protected with two 1/16 inch coats of Childers CP/10 or CP/11 weather barrier coating.
- E. Manufacturer and Model
 - 1. Owens - Corning SSL-11
 - 2. Manville Micro - Lok
 - 3. Knauff - ASJ-SSL
 - 4. Certainteed - Alley-K

2.3 ADHESIVES AND COATINGS

A. Manufacturer and Model	Insulcoustic	Benjamin-Foster	Childers
Vapor Barrier Adhesive	225	80-07	CP-54
Vapor Barrier Coating	501	30-35	CP-30
Lagging Adhesive	102	30-36	CP-52
Insulation Adhesive	225	85-20	CP-54
Glass Cloth Adhesive	225	85-20	CP-54
Weatherproofing Mastic	VI-AC	48-00	CP-10/11

PART 3 - EXECUTION

3.1 GENERAL

- A. Insulation shall be applied on clean, dry surfaces.
- B. Insulation shall be continuous through hangers, construction openings, and sleeves.
- C. Insulation on cold surfaces where vapor barrier jackets are required shall be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors and similar devices that are secured directly to cold surfaces shall be adequately insulated and vapor sealed to prevent condensation.
- D. For pipe handling fluids below 70°F, provide one of the following means of preventing contact between pipe insulation and hanger or support:
 - 1. High density rigid fiberglass insulation insert, equal in thickness to pipe insulation, with factory applied jacket and metal protection shield. Protection shield shall be installer

between provided between pipe and hanger or support.

- a. For piping 5 inches in diameter and smaller protection shield width shall be 18 gauge and equal to 1/2 the outside insulation diameter and 12 inches in length.
 - b. For piping 6 inches in diameter and larger protection shield shall be 16 gauge and equal to 1/2 the outside diameter and a length of 24 inches.
- E. For piping handling fluids 70°F and above, rest pipe directly on hanger, insulate pipe and hanger.
- F. Apply insulation in accordance with manufacturer's recommendations.
- G. Piping located on roof shall have 18 gauge stainless steel shield a minimum of 36 inches in length the full circumference of pipe. Locate where insulation will be stepped on due to maintenance traffic.

END OF SECTION 220719

SECTION 220800 - PLUMBING SYSTEM COMMISSIONING PARTICIPATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. The purpose of this section is to specify the Division 22 Contractor's responsibilities and participation in the commissioning process.
- B. Commissioning is primarily the responsibility of the Commissioning Agent, with support for start-up, testing, and commissioning from plumbing contractor. The commissioning process does not relieve the plumbing contractor from participation in the process or diminish the role and obligations to complete all portions of work in a satisfactory and fully operational manner.
- C. Commissioning participation associated with Division 22 includes:
 - 1. Start-up and testing of systems and equipment.
 - 2. Assistance for balancing and adjusting as required for commissioning.
 - 3. Work with on site commissioning agent in order to demonstrate and operate equipment.
 - 4. Operation of systems and equipment as required for commissioning tests.
 - 5. Provide equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
 - 6. Provide operation and maintenance manuals, specifications, and as-built drawings to the Commissioning Agent for verification, organization, and distribution.
 - 7. Provide assistance and Test Engineer to develop and edit system operation descriptions.
 - 8. Provide training for the installed systems and coordinate with the Test Engineer, Owners Representative, and Commissioning Agent.
 - 9. Maintain and fill out pre-functional test sheets for all equipment to be commissioned.

1.3 RELATED WORK

- A. All testing and start-up procedures and documentation requirements specified within Division 1, Division 22, and related portions of this project.
- B. Cooperate with the Commissioning Agent in the following manner:
 - 1. Install balancing cocks, access doors, test ports, and P&T taps as required by the Commissioner and/or the test and balance agency.

2. Allow sufficient time before final completion dates so that test and balance and commissioning testing can be accomplished.
3. Provide labor and material to make corrections when required without undue delay.
4. Put all systems and equipment into full operation and continue the operation of the same during each working day of testing, balancing and commissioning.

1.4 SUMMARY

A. This Section includes the following:

1. Start-Up and Testing
2. Work Prior to Commissioning
3. Participation in Commissioning
4. Work to Resolve Deficiencies
5. Additional Commissioning
6. Training
7. System Documentation

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 START-UP AND TESTING

- A. Standard test equipment for commissioning will be provided by the Commissioning Agent.
- B. Division 22 shall provide standard and specialized test equipment as necessary to test and start up the plumbing systems and equipment.
- C. Proprietary test equipment required by the manufacturer shall be provided by the manufacturer of the equipment. Manufacturer shall provide start-up, the test equipment, demonstrate its use, and assist the Commissioning Agent in the commissioning process.

3.2 WORK PRIOR TO COMMISSIONING

- A. Complete all phases of work so the system can be started, tested, balanced, and otherwise commissioned. Division 22 has primary start-up responsibilities with obligations to complete systems, including all sub-systems so they are functional. This includes the complete installation of all equipment, materials, pipe, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, change orders, etc.
- B. A commissioning plan will be developed by the Commissioning Agent. Upon request of the Commissioning Agent, this Contractor shall provide assistance and consultation. The commissioning plan will be developed prior to completion of the installation. This Contractor is obligated to assist the Commissioning Agent in preparing the commissioning plan by providing all necessary information pertaining to the actual equipment and installation. If system modifications/ clarifications are incorporated to this and related sections of work, commissioning of this work will be made at no additional cost to the Owner. If Contractor-initiated system changes have been made that alter the commissioning process, the Commissioning Agent will

notify the Architect, and the Contractor may be obligated to compensate the Commissioner to test the revised product, or confirm the suitability/unsuitability of the substitution or revision.

C. Specific pre-commissioning responsibilities of Division 22 are as follows:

1. Normal start-up services required to bring each system into a fully operational state. This includes motor rotational check, cleaning, filling, purging, leak testing, full-load and part-load performance, etc. The Commissioning Agent will not begin the commissioning process until each system is complete, including normal contractor start-up.
2. The Contractor shall perform pre-functional tests on the following equipment and systems. Contractor start-up forms may be substituted for the pre-functional test forms with prior approval by the Commissioning Agent.
 - a. Hot water system and equipment
 - b. Cold water system and equipment
3. Factory start-up services will be provided for key equipment and systems specified in Division 22. This Contractor shall coordinate this work with the manufacturer and the Commissioner.

D. Commissioning is intended to begin upon completion of a system. Commissioning may proceed prior to the completion of systems and/or sub-systems, if expediting this work is in the best interests of the Owner. Commissioning activities and schedule will be coordinated with the Contractor. Start of commissioning before system completion will not relieve the Contractor from completing those systems as per the schedule.

3.3 PARTICIPATION IN COMMISSIONING

- A. Provide skilled technicians to start-up and debug all systems within the division of work. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Agent and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. System problems and discrepancies may require additional technician time, Commissioning Agent time, redesign and/or reconstruction of systems, and system components. The additional technician time shall be made available for the subsequent commissioning periods until the required system performance is obtained.
- C. The Commissioning Agent reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Agent to get the job done. A liaison or intermediary between the Commissioning Agent and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.

3.4 WORK TO RESOLVE DEFICIENCIES

- A. In some systems, mis-adjustments, mis-applied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work will be completed under the direction of the Architect, with input from the Contractor, equipment supplier, and Commissioning Agent. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Architect/Engineer of Record will have final jurisdiction on the necessary work to be done to achieve performance.
- B. Corrective work shall be completed in a timely fashion to permit the timely completion of the commissioning process. Experimentation to render system performance will be permitted. If the Commissioning Agent deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Agent will notify the Architect/Engineer indicating the nature of the problem, expected steps to be taken, and the deadline for completion of activities. If the deadline(s) passes without resolution of the problem, the Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner will be the Contractor's responsibility.

3.5 ADDITIONAL COMMISSIONING

- A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor, suppliers, and Commissioning Agent shall include a reasonable reserve to complete this work as part of their standard contractual obligations.

3.6 TRAINING

- A. This Contractor will be required to participate in the training of the Owner's engineering and maintenance staff for each mechanical system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner's option.
- B. Training will be conducted jointly with the Commissioning Agent, the equipment vendors, and the Contractor. The Contractor will be responsible for the generic training, as well as instructing the Owner's staff on the system peculiarities specific to this project.

3.7 SYSTEMS DOCUMENTATION

- A. In addition to the requirements of Division 1, update Contract Documents to incorporate field changes and revisions to system designs to account for actual constructed configurations. All drawings shall be red-lined on two sets. Division 22 as-built drawings shall include updated architectural floor plans, and the individual mechanical systems in relation to actual building layout.
- B. Maintain as-built red-lines on the job site as required in Division 1. Given the size and complexity of this project, red-lining of the drawings at completion of construction, based on memory of key personnel, is not satisfactory. Continuous and regular red-lining and/or posting of drawings is considered essential and mandatory.
- C. In addition to the stated requirements for operation and maintenance data, provide one copy of equipment technical literature, operation and maintenance literature, and shop drawings to the

Commissioning Agent as soon as they are available. This requirement is for review of these documents prior to distribution of multiple copies for the Owner's final use.

END OF SECTION 220800

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Construction and materials shall be in accordance with the City of Rockville standards and specifications.
- C. This section applies to all domestic and fire water supply lines located outside 5 feet from the face of the building.

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water mains.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of special testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Owner no fewer than three days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.
- C. Flanges: ASME 16.1, Class 125, cast iron.

2.2 JOINING MATERIALS

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.

2.3 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.4 CORROSION-PROTECTION PIPING ENCASEMENT

- A. Encasement for Underground Metal Piping:
 1. Standards: ASTM A 674 or AWWA C105.
 2. Form: Tube.
 3. Material: LLDPE film of 0.008-inch minimum thickness, or high-density, crosslaminated PE film of 0.004-inch minimum thickness.
 4. Color: Black

2.5 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
 1. Available Manufacturers: Subject to compliance with requirements of the City of Rockville.

2.6 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:
 1. Available Manufacturers: Subject to compliance with requirements of the City of Rockville.

2. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 4 to NPS 8 shall be any of the following:
 1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

3.5 PIPING INSTALLATION

- A. Make connections larger than NPS 2 with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- B. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- C. Bury piping with depth of cover over top at least 48 inches with top at least 12 inches below level of maximum frost penetration, and according to the following:
- D. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- E. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- F. Sleeves are specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- G. Mechanical sleeve seals are specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- I. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

3.6 JOINT CONSTRUCTION

- A. See Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Make pipe joints according to the following:
 - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.

3.7 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Locking mechanical joints.
 - 3. Set-screw mechanical retainer glands.
 - 4. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

3.9 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. See Division 22 Section "Common Work Results for Plumbing" for piping connections to valves and equipment.
- C. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve.
- D. Connect water-distribution piping to interior domestic water piping.

3.10 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Conduct test in accordance with City of Rockville Standards and Specifications.
- C. Prepare reports of testing activities.

3.11 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

3.12 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 PIPING SYSTEM STANDARDS OF MATERIALS

- A. Domestic water systems which connect to HVAC equipment, components, and associated appurtenances shall be terminated within five feet of final connection point with a shutoff valve and cap. Final connection to HVAC equipment, components, and associated appurtenances shall be provided under the HVAC section.
- B. Domestic water systems which connect to plumbing fixtures, equipment, components and associated appurtenances as indicated under another divisions drawings or specifications shall be provided with rough-in and final connection. Plumbing contractor shall coordinated exact location of rough – in and final connection.
- C. Each pipe length shall have the manufacturer's name cast, stamped, or rolled on.
- D. Each fitting shall have the manufacturer's symbol and pressure rating cast, stamped, or rolled on.

1.3 SUMMARY

- A. This section includes the following:
 - 1. Building Water Main Piping
 - 2. Cold Water Piping – Interior
 - 3. Hot Water Piping – Interior
 - 4. Hot Water Return Piping – Interior
 - 5. Trap Primer Water Piping – Interior
 - 6. Trap Primer Water Piping – Below Grade
 - 7. Installation and Testing
 - 8. Adjusting and Balancing

PART 2 – PRODUCTS

2.1 PIPING AND FITTINGS MATERIAL SCHEDULE

- A. Domestic water systems shall be constructed of the following materials, subject to approval by authorities having jurisdiction.

- 1. Building Water Main Piping

- Pipe: Type L hard drawn copper – ASTM B75, ASTM B88, ASTM B251, ASTM B447

Fittings: Standard wrought copper – ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.23, ASME B16.26, ASME B16.29, ASME B16.32

Joints: 4 inches and smaller - 95/5 tin antimony solder – ASTM B32 and flux conforming to ASTM B 813.

Manufacturer: Nibco; Mueller

Remarks: Provide in accordance with manufacturers requirements

The joining of piping shall be made with lead free solder and fluxes. "Lead Free" shall mean a chemical composition equal to or less than 0.2-percent lead.

2. Cold Water (CW) Piping – Interior

Pipe: Type L hard drawn copper – ASTM B75, ASTM B88, ASTM B251, ASTM B447

Fittings: Standard wrought copper – ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.23, ASME B16.26, ASME B16.29, ASME B16.32

Joints: 4 inches and smaller - 95/5 tin antimony solder – ASTM B32 and flux conforming to ASTM B 813.

Manufacturer: Nibco; Mueller

Remarks: Provide in accordance with manufacturers requirements

The joining of piping shall be made with lead free solder and fluxes. "Lead Free" shall mean a chemical composition equal to or less than 0.2-percent lead.

3. Hot Water (HW) Piping – Interior

Pipe: Type L hard drawn copper – ASTM B75, ASTM B88, ASTM B251, ASTM B447

Fittings: Standard wrought copper – ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.23, ASME B16.26, ASME B16.29, ASME B16.32

Joints: 4 inches and smaller - 95/5 tin antimony solder – ASTM B32 and flux conforming to ASTM B 813.

Manufacturer: Nibco; Mueller

Remarks: Provide in accordance with manufacturers requirements

The joining of piping shall be made with lead free solder and fluxes. "Lead Free" shall mean a chemical composition equal to or less than 0.2-percent lead.

4. Hot Water Return (HR) Piping– Interior

Pipe: Type L hard drawn copper – ASTM B75, ASTM B88, ASTM B251, ASTM B447

Fittings: Standard wrought copper – ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.23, ASME B16.26, ASME B16.29, ASME B16.32

Joints: 95/5 tin antimony solder – ASTM B32 and flux conforming to ASTM B 813.

Manufacturer: Nibco; Mueller

Remarks: Provide in accordance with manufacturers requirements

The joining of piping shall be made with lead free solder and fluxes. "Lead Free" shall mean a chemical composition equal to or less than 0.2-percent lead.

5. Trap Primer Water (TPW) Piping – Interior

Pipe: Type L hard drawn copper – ASTM B75, ASTM B88, ASTM B251, ASTM B447

Fittings: Standard wrought copper – ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.23, ASME B16.26, ASME B16.29, ASME B16.32

Joints: 95/5 tin antimony solder – ASTM B32 and flux conforming to ASTM B 813.

Manufacturer: Nibco; Mueller

Remarks: Provide in accordance with manufacturers requirements

The joining of piping shall be made with lead free solder and fluxes. "Lead Free" shall mean a chemical composition equal to or less than 0.2-percent lead.

6. Trap Primer Water (TPW) Piping – Below Grade

Pipe: Cross – linked Polyethylene Plastic Tubing (PEX) – ASTM F 876, ASTM F 877
 Cross – Linked Polyethylene (PEX) – ASTM F877

Fittings: Metal Insert Fittings Utilizing a Copper Crimp Ring SDR9 (PEX) – ASTM F 1807
 Copper Crimp Ring SDR (PEX) – ASTM F1807

Joints: Mechanical

Manufacturer: Zurn; Wirsbo; Viega

Remarks: Provide in accordance with manufacturers requirements

2.2 PLUMBING PIPING SYSTEM PRESSURE CLASSIFICATION

- A. Piping, fittings, components, and equipment for the various plumbing piping systems shall meet the following pressure requirements:

Plumbing Piping System	Maximum Operating	Component Pressure Rating
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	Pressure	
Cold Water	75	125
Hot Water	75	125
Hot Water Return	75	125
Trap Primer Water	75	125

PART 3 – EXECUTION

3.1 GENERAL

- A. Provide provision for expansion and contraction in the piping systems, to prevent undue stress or strain on piping, building anchor points, and connected equipment.
- B. Piping connections to plumbing fixtures and equipment shall be provided with offsets, unions, and shutoff valves arranged such that equipment can be serviced or removed without dismantling the pipe.
- C. Pitch water piping up in direction of flow to ensure adequate flow without air binding and to prevent noise and water hammer. Branch connections to mains shall be made in such a manner as to prevent air trapping and prevent free passage of air.
- D. Converging or diverging Bullheaded Tee's are not permitted in piping systems.
- E. Provide hose drain connections on downstream of floor main shut-off valves.
- F. T-Drill type fittings are not permitted in piping systems.

3.2 INSTALLATION AND TESTING

A. Installation Procedures

- 1. Water piping shall be arranged to drain to low points and to provide for air elimination at high points.
- 2. Mains, risers and branch connections to same shall be arranged to permit expansion and contraction without strain by means of elbow swings and/or expansion joints.
- 3. Provide a riser control valve and drain valve for each riser. Drain valve shall be located downstream of riser control valve on upfeed risers.
- 4. Valves, check valves, reducing valves, shock absorbers, tempering valves, etc. shall be easily accessible for maintenance and/or removal.
- 5. Screwed joints shall be made with best quality approved pipe compound, carefully placed on male threads only and not on the fittings.
- 6. Cut and threaded pipe shall have the cutting burrs and sharp edges reamed out.
- 7. In erecting pipe, friction wrenches shall be used exclusively, and any pipe cut, dented or otherwise damaged shall be replaced.
- 8. Ferrous to non-ferrous pipe connections shall be made with dielectric pipe or flange union isolating joints to prevent any electrolytic action between dissimilar metals.
- 9. Copper pipe and tubing shall be cut square and reamed out to remove burrs. Outside and

inside of the fittings and outside of the tubing at each end shall be well cleaned with steel wool before brazing to remove traces of oxidation regardless of how clean the surfaces of the pipe and fittings may appear.

B. System Pressure Test

1. Each water system shall be tested to a hydrostatic pressure equal to 1-1/2 times the system normal operating pressure.
2. The water used for the pressure test shall be supplied from a potable water source.
3. Take all due precautions to prevent damage to the building and its contents that may be incurred by such tests; repair or make good any damage caused by the tests.
4. Tests shall apply full test pressure to the piping for a sufficient period of time to detect leaks and defects.
5. Tests shall be conducted prior to the installation of insulation. If delicate control mechanisms, not including control valves, are installed in the piping, they shall be removed to prevent shock damage.
6. The section of piping to be tested shall be brought up to the specified test pressure. If the test pressure falls more than the specified amount during the test period, the point of leakage shall be found, repaired and the test repeated. This procedure shall be repeated until the piping system has been proved absolutely tight.
7. Leaks shall be repaired by removing the valve, fitting, joint or section that is leaking and reinstalling new materials and joints as specified. Use of mastic or "no-leak" compounds or other temporary means of repairing leaks shall not be permitted.

C. Cleaning, Flushing and Disinfection

1. Before being placed in operation, the water piping systems shall be cleaned, flushed and disinfected in strict accordance with the requirements of the local health department or other authorities having jurisdiction.
2. The piping systems shall be sterilized with a solution containing not less than 50 parts per million of chlorine, which shall conform to the standards of the American Water Works Association, and the solution shall be introduced into the system in an approved manner. The solution shall be allowed to remain in the system for a minimum period of 24 hours. During the sterilization period, valves and outlets shall be opened and closed several times. After the sterilization period, the solution shall be flushed from the system using clean water until the residual chlorine content is less than 0.2 parts per million, or as required by the local health department or other authority having jurisdiction.
3. Required water samples shall be taken and submitted to an approved laboratory for routine bacteriological examination. Copies of the test results shall be submitted to the Architect and the local health department or other authority having jurisdiction.
4. Provide the means for disposing the solution used to disinfect the system. The solution shall be disposed of in an approved manner that shall eliminate the possibility of damage to property or contamination of the water supply.

3.3 ADJUSTING AND BALANCING

- A. After completion of the installations and prior to acceptance by the Owner, water systems and appurtenances shall be adjusted and balanced to deliver the water quantities as specified,

indicated on the drawings, or as directed. Modify pumps and/or controls to produce design flow.

- B. Pump capacities shall be determined by differential pressure measurements. Pump balancing valves shall be adjusted to provide the lowest discharge pressure possible while maintaining flow to all devices.
- C. Water circuits shall be adjusted by calibrated balancing valves provided as part of the installation, and calibrated balancing valves shall be permanently marked after final balance is complete so that they may be returned to their correct position if disturbed.
- D. The following data shall be recorded for each water system:
 - 1. Pump motor current and voltage.
 - 2. Entering and leaving water flow rates, temperatures and pressures.
 - 3. Differential pressure across pumps.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL

- A. Provide plumbing piping specialties as shown on the drawings and specified herein.

1.3 SHOCK ABSORBERS

- A. Provide shock absorbers on water supplies to solenoid valves, immediately adjacent to equipment wherein quick-closing valves are installed, at each master PRV installation, and as indicated on the drawings.

1.4 TRAP SEAL PRIMER VALVES

- A. Provide trap seal primer valves as indicated on the drawings and as specified herein.

1.5 WATER PRESSURE REDUCING VALVE

- A. Provide water pressure reducing valve as indicated on drawings and as specified herein.

1.6 WATER PRESSURE BOOSTER PUMP

- A. Provide water pressure booster pump as indicated on drawings and as specified herein.

1.7 HOT WATER RECIRCULATION PUMP

- A. Provide hot water recirculation pump as indicated on drawings and as specified herein.

1.8 SUMMARY

- A. This section includes the following:
 - 1. Shock absorbers
 - 2. Trap seal primer valves
 - 3. Water pressure reducing valves
 - 4. Water pressure booster pump
 - 5. Domestic hot water recirculation pump.

PART 2 - PRODUCTS

2.1 SHOCK ABSORBERS

- A. Shock absorbers for general use shall be nested stainless steel bellows type contained within a sealed stainless steel chamber. Shock absorbers shall be sized in accordance with the manufacturer's recommendations.

B. Manufacturer and Model

1. Zurn Z-1700 Shocktrol
2. Josam Series 75000 Water Hammer Arrestors
3. J.R. Smith Series 5000 Hydrotrol

2.2 TRAP SEAL PRIMER VALVES

A. Floor drains or traps not subject to water seal on a daily basis shall be provided with a trap primer valve and associated appurtenances.

1. Pressure Differential Trap Primer Valve, TP-1
 - a. Pressure differential trap priming valve shall be automatically activated when trap primer valve senses a cold water pressure drop of 5 to 10 psig. Trap primer valve shall be provided with a distribution unit when required to supply more than one floor drain trap.
 - b. Manufacturer and Model
 - 1) Precision Plumbing Products Inc. – Model PR-500

2.3 WATER PRESSURE REDUCING VALVE

A. Provide pressure reducing valve with strainer conforming to ASSE 1003. Pressure reducing valve shall be capable of reducing water pressure within building to 80 psi static or less. Pressure reducing valve shall provide constant downstream pressure regardless of flow rate or inlet pressure.

B. Water pressure reducing valves shall be as specified here:

1. Pipe sizes 1/2 inch through 3/4 inch shall be provided with integral strainer and have an adjustable pressure range from 25 to 75 psi.
 - a. Manufacturer and Model
 - 1) Watt Series N250
 - 2) Wilkins Series Model 70
2. Pipe sizes 1-1/4 inch through 12 inch shall be automatic diaphragm actuated, pilot controlled, hydraulically operated.
 - a. Manufacturer and Model
 - 1) Watts Series 115-2 Pressure Reducing ACV with strainer
 - 2) Wilkins Series ZW127-3B with strainer

2.4 WATER PRESSURE BOOSTER PUMP, BP-1

A. Water pressure booster pump shall be a variable speed factory assembled, completely skid mounted, pre-piped, pre-wired and programmed duplex system. Lead pump and Lag pump 50% capacity each.

- B. System shall include Horizontal Mounted Close coupled End Suction Centrifugal Pumps with ANSI Flanged Connections. Pump features to include Foot Supported Casing, Hydraulically Balanced Impeller. Pump shall be Cast Iron Bronze fitted construction with a replaceable shaft sleeve and mechanical seal. Motor shall be NEMA close coupled type with a JM frame.
- C. Pumps rating:
1. Pump No. 1 shall be rated – 75 GPM at 25 psi boost
 2. Pump No. 2 shall be rated – 75 GPM at 25 psi boost
- D. Motors shall be 208 volt, 3 phase, 60 Hz open drip proof and manufactured in accordance with NEMA standards.
1. Pump No. 1 shall be 3 HP
 2. Pump No. 2 shall be 3 HP
- E. Control panel shall have all UL listed devices of “Touch Safe” design, which shall eliminate any barehanded shock hazard. All Primary & Secondary Power Devices shall be shrouded, modular “Touch Safe” design for safe removal without the use of tools. The Primary Motor Branch Circuits shall have a Thermal Magnetic Circuit Breaker Protection.
- F. Enclosure – The Pump Controller and all of its Components shall be housed in a NEMA 1 UL Listed Enclosure. The Enclosure shall have a Main Power Disconnect Switch with External Handle, Circuit Breakers, DC Power Supply, Vents, Piezoelectric Horn and Cables. The Enclosure shall provide for a Single Point Electrical Connection with all Power, both Primary and Secondary to be De-Activated when opening the Main Disconnect Switch.
- G. PLC – Provide, mount and wire on the skid a Programmable Logic Controller (PLC), to interface the signal from the Pressure Sensor to the VFD’s and provide a stabilized response to speed up or slow down the Lead pump or add the Lag Pump to meet the system requirements.
- H. Touch screen – The Touch Screen/HNI includes a 5.7” STN Blue-Mode/Color display with Analog Touch Screen, On-Board Interfaces for Communication with MPI, PROFIBUS,

PROFINET. All user adjustments shall be made through the Password Protected Adjustment Screen without opening the Panel Door. The Touch Screen to include the following features:

- a. Home Screen (Water Flow Animation/Hertz/System Set-point & Actual Pressure/System Condition Status);
- b. Pump Status (Hertz/Amps/Run Hours);
- c. Customer Adjustments;
- d. Screen Settings (Calibrate/Clean Screen/Set Time-Date);
- e. Project Information;
- f. Spare Parts;

- g. Alarm Log;
 - h. Trend Graph over time (Set Point vs. Actual);
 - i. Programming (Pressure Settings, VFD Settings, Calibration, PID Loop, Lead-Lag, Pressure Bands, Time Delays, Trend)
 - I. Alarms – All Alarm Settings shall be adjustable through the Touch Screen/HMI Panel. These settings shall include:
 - a. High System Shutdown;
 - b. High System Warning; c.
Low System Shutdown; d.
Low System Warning;
 - e. Pressure Transducer Fail Speed;
 - f. Pump Fault.
 - J. Variable Speed Drives and Pressure Transmitter shall be provided per the Manufacturer's instructions;
 - K. System valves – Each pump shall have Suction/Discharge Full Port Isolation Ball Valves with Stainless Steel Ball & Stem. Each Pump Discharge shall have Silent Non-Slam Check Valve with Stainless Steel Ball & Stem, and sized for a maximum loss of 3 PSI at Design Flow and be suitable for the maximum working pressure of the System.
 - L. Fabrication – All Headers, Nipples and Welded attachments to the Headers shall be Type 304 Stainless Steel materials. All welding shall be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. All welding on Stainless Steel piping shall be performed by welders qualified under that standard.
 - M. Factory Assembly – The Duplex Pump system shall be factory assembled on a 304 Stainless Steel welded Structural Baseplate including Suction/Discharge Headers, Pumps, Motors, Control Panel, Valves, Piping and Wiring. Provide isolation valves on the Suction and Discharge of each Pump.
 - N. Manufacturer and Model
 - 1. Sensillo – Model DES-AR2-208
 - 2. Amrstrong
 - 3. Canariis
- 2.5 HOT WATER RECIRCULATION PUMP RCP-2
- A. Pump shall be all-bronze construction, with bronze sleeve mechanical seal, and oil lubricated bearings.
 - B. Pump shall be non-overloading at any point on the pump curve.

1. Pump shall be 3 gpm @ 15 ft hd, 1/12 hp, 1phase, 115 volt with built in overload protection.

C. Manufacturer and Model

1. Bell & Gossett – Series PL-30B
2. Taco – Model 111
3. Armstrong – Model S-25

PART 3 - EXECUTION

3.1 SHOCK ABSORBERS

- A. Provide shutoff valves between each shock absorber and the piping served to permit removal of shock absorber while the system is under pressure.

END OF SECTION 221119

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Construction and materials shall be in accordance with the City of Rockville standards and specifications.
- C. This section applies to sanitary sewer lines located outside 5 feet from the face of the building.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Nonpressure and pressure couplings.
 - 3. Manholes.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Expansion joints and deflection fittings.
 - 2. Backwater valves.
- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
- E. Field quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

- C. Handle manholes according to manufacturer's written rigging instructions.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than three days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

- A. Pipe: ASTM A 746, for push-on joints.
- B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
- C. Compact Fittings: AWWA C153, ductile iron, for push-on joints.
- D. Gaskets: AWWA C111, rubber.

2.2 PVC PIPE AND FITTINGS

- A. PVC Type PSM Sewer Piping:
 - 1. Pipe: ASTM D 3034, SDR 35 PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM D 3034, PVC with bell ends.
 - 3. Gaskets: ASTM F 477, elastomeric seals.

2.3 CLEANOUTS

- A. PVC Cleanouts:
 - 1. Comply with City of Rockville Standards and Specifications.
 - 2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.4 MANHOLES

- A. Standard Precast Concrete Manholes:

1. Description: Comply with City of Rockville Standards and Specifications.

2.5 CONCRETE

- A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R , and the following:
 1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
 1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.
- C. Manhole Channels and Benches: Comply with City of Rockville Standards and Specifications.

PART 3 - PRODUCTS

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
 2. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
- G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
1. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
 2. Join dissimilar pipe materials with nonpressure-type, rigid couplings.

3.4 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.
- E. Install manhole-cover inserts in frame and immediately below cover.

3.5 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

3.7 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."
- B. Make connections to existing piping and underground manholes.
 - 1. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.8 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
 - 1. Use detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.9 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate report for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.

5. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
 - b. Option: Test concrete gravity sewer piping according to ASTM C 924.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.10 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 221313

SECTION 221316 - SANITARY AND VENT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 PIPING SYSTEM STANDARDS OF MATERIALS

- A. Sanitary and vent systems which are provided to serve HVAC equipment, components, and associated appurtenances shall be located within five feet of equipment drain point. Plumbing contractor shall coordinate exact locations of HVAC drain points with Mechanical Contractor prior to rough-in of floor drains. HVAC drain piping, equipment, components, and associated appurtenances shall be provided under the HVAC section.
- B. Each pipe length shall have the manufacturer's name cast, stamped, or rolled on.
- C. Each fitting shall have the manufacturer's symbol and pressure rating cast, stamped, or rolled on.

1.3 SUMMARY

- A. This section includes the following:
 - 1. Sanitary piping – Interior
 - 2. Sanitary piping – Below grade
 - 3. Vent piping – Interior
 - 4. Vent piping – Below grade
 - 5. Installation and Testing

PART 2 – PRODUCTS

2.1 PIPING AND FITTINGS MATERIAL SCHEDULE

- A. Sanitary and vent systems shall be constructed of the following materials, subject to approval by Authorities having jurisdiction.
 - 1. Sanitary (SAN) Piping– Interior
 - Pipe: No-hub Cast Iron – ASTM A74, ASTM A888, CISPI 301 and be marked with the collective material trade mark of the Cast Iron Soil and Pipe Institute
 - Fittings: No-hub Cast Iron drainage – ASME B16.4, ASTM B16.12, ASTM A74, ASTM A888, CISPI 301

Joints: 4 inches and smaller – cast iron neoprene gasket with heavy duty stainless steel coupling and four stainless steel bands
5 inches to 10 inches – Cast Iron neoprene gasket with heavy duty stainless steel coupling and six stainless steel bands

Pipe Manufacturer: Tyler Pipe; Charlotte Pipe

Coupling Manufacturer: Mission Heavy Weight; Husky 4000

Remarks Provide in accordance with manufacturers requirements.

2. Sanitary (SAN) Piping– Below Grade

Pipe: Service weight hub and spigot Cast Iron – ASTM A74, ASTM A888, CISPI 301 and be marked with the collective material trade mark of the Cast Iron Soil and Pipe Institute

Fittings: Cast Iron hub and spigot – ASTM A74, ASTM A888, CISPI 301

Joints: Rubber compression gaskets – ASTM C564

Pipe Manufacturer: Tyler Pipe; Charlotte Pipe

Remark: Provide in accordance with manufacturers requirements
Minimum 2 inch pipe size permitted below grade.

3. Vent (V) Piping – Interior

Pipe: No-hub Cast Iron – ASTM A74, ASTM A888, CISPI 301 and be marked with the collective material trade mark of the Cast Iron Soil and Pipe Institute

Fittings: No-hub Cast Iron drainage – ASME B16.4, ASTM B16.12, ASTM A74, ASTM A888, CISPI 301

Joints: 4 inches and smaller – cast iron neoprene gasket with heavy duty stainless steel coupling and four stainless steel bands
5 inches to 10 inches – Cast Iron neoprene gasket with heavy duty stainless steel coupling and six stainless steel bands

Pipe Manufacturer: Tyler Pipe; Charlotte Pipe

Coupling Manufacturer: Mission Heavy Weight; Husky 4000

Remarks: Provide in accordance with manufacturers requirements.

4. Vent (V) Piping – Below Grade

- Pipe: Service weight hub and spigot Cast Iron – ASTM A74, ASTM A888, CISPI 301 and be marked with the collective material trade mark of the Cast Iron Soil and Pipe Institute
- Fittings: Cast Iron hub and spigot – ASTM A74, ASTM A888, CISPI 301
- Joints: Rubber compression gaskets – ASTM C564
- Pipe: Tyler Pipe; Charlotte Pipe
- Manufacturer:
- Remark: Provide in accordance with manufacturers requirements

2.2 PLUMBING PIPING SYSTEM PRESSURE CLASSIFICATION

- A. Piping, fittings, and components, for the sanitary and vent piping systems shall be capable of withstanding the following:

<u>Plumbing Piping System</u>	<u>Minimum Working Pressure</u>	<u>Sanitary</u>
10 foot head of water	Vent	10 foot head of water

PART 3 – EXECUTION

3.1 GENERAL

- A. Provide provision for expansion and contraction in the piping systems, to prevent undue stress or strain on piping, building anchor points, and connected equipment.
- B. Piping passing through roof construction shall be arranged to provide a minimum of 12 inch clearance from walls or other obstructions so as to permit proper flashing. Set pipe flashing fittings at a suitable level above the roof to permit proper termination of flashing.

3.2 INSTALLATION AND TESTING

A. Installation Procedures

1. Slope of horizontal piping
 - a. Sanitary piping 2-1/2 inches and smaller shall be sloped at a minimum pitch of 1/4 inch per foot.
 - b. Sanitary piping 3 inches to 6 inches shall be sloped at a minimum pitch of 1/8 inch per foot.
 - c. Sanitary piping 8 inches or larger shall be sloped at a minimum pitch of 1/16 inch per foot.
2. Connections to stacks or main drains shall be made in a manner that shall not permit backflow.
3. Vent piping shall be arranged to drain any condensate back to drainage piping.
4. Provide test tees in vertical risers as required to permit testing in sections.

5. Pipe shall have the cutting burrs and sharp edges reamed out.
6. When connecting to existing sanitary piping system, clean out piping from tie-in to next downstream cleanout.

B. System Testing

1. The entire sanitary and vent piping system shall be subjected to testing in accordance with applicable codes. Plumbing contractor shall provide all equipment, material, labor and associated appurtenances necessary for drainage system testing.
2. The sanitary and vent piping systems shall be provided with two separate tests. The first test shall occur during the installation and the final test shall occur after the plumbing fixtures have been set and their traps filled with water. The entire sanitary and vent piping system shall be submitted to the final test.
3. Sanitary and vent piping systems testing during construction shall be provided by utilizing either water or air.

a. Water Test

- 1) A water test shall be applied to the sanitary and vent piping system either in its entirety or in sections. If applied to the entire system, all openings in the piping system shall be tightly closed, except the highest opening, and the system shall be filled to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test. The section shall be filled with no less than a 10 foot head of water.
- 2) The water shall be kept in the system, or in a portion under test, for at least 15 minutes before inspection starts.
- 3) In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested so that no joint or pipe in the building, except for the uppermost 10 feet of the system, shall have been submitted to a test of not less than a 10 foot head of water.

b. Air Test

- 1) An air test shall be applied to the sanitary and vent piping system either in its entirety or in sections. All openings in the piping system shall be tightly closed and the system shall be filled with air until there is a uniform gauge pressure of 5 pounds per square inch or a pressure sufficient to balance a 10 inch column of mercury.
- 2) This pressure shall be held for a period of at least 15 minutes. Any adjustment to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period.

4. Final Test shall be conducted using a smoke test.

- a. The smoke test shall be conducted by filling traps with water and then introducing into the entire system a pungent, thick smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, the opening

shall be closed and a pressure equivalent to a 1 inch water column shall be maintained for 15 minutes before inspection starts.

3.3 Video / Audio Pipe Inspection

- A. Plumbing contractor shall coordinate periodic video / audio inspection of interior and below grade sanitary drainage piping, sanitary risers, vent piping, vent risers, and other portions of the drainage system as requested by the Owner. At a minimum, periodic video / audio inspections shall occur as follows:
 - 1. After all below grade sanitary and vent piping is installed and tested but prior to pouring of concrete floor.
 - 2. After all below grade sanitary and vent piping is installed and concrete floor is poured.
 - 3. After final topping of concrete and / or final grouting of floor.
 - 4. Sanitary and vent piping that will be concealed in shafts, chases, walls, etc., at the end of the project
 - 5. At the end of the project prior to turn over to Owner.
- B. Video / audio inspection shall include alpha-numeric data on the image indicating date, time, and pipe identification.
- C. Plumbing contractor shall:
 - 1. Provide removal of cleanouts, plumbing fixture, or traps as required for camera access into drainage system and replace after inspection.
 - 2. Provide removal obstructions encountered in the sanitary and vent drainage system during inspection in there entirety. Any demolition of roofs, walls, floors, landscape, or other building components associated with removal of obstruction shall be replaced to match conditions prior to demolition.
 - 3. Provide documentation of video / audio camera inspection locations on contractors As-Built floor plans and riser diagrams during inspection.
- D. During video / audio inspection, if any portion of the drainage system is found not to be installed with the proper slope in accordance with the Plumbing Code, the Plumbing Contractor shall replace piping, fittings, and appurtenances as required to ensure proper operation of entire drainage system.

END OF SECTION 221316

SECTION 221319 - SANITARY AND VENT PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL

- A. Provide sanitary and vent piping specialties as shown on drawings and as specified herein.

1.3 CLEANOUTS

- A. Provide cleanouts as required by local codes and authorities, as shown on drawings, and as specified herein.

1.4 ELEVATOR PIT SUMP PUMP

- A. Provide elevator pit sump pump as shown on drawings and as specified herein.

1.5 SUMMARY

- A. This section includes the following:
 - 1. Cleanouts
 - 2. Elevator pit sump pump

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Cleanouts shall be full size of pipe up to 4 inches, and shall be 4 inches for larger sizes. Cleanouts on piping 6 inches and smaller shall be provided with a clearance of not less than 18 inches for rodding. Cleanouts on piping 8 inches and larger shall be provided with a clearance of not less than 36 inches for rodding.
- B. Cleanouts on concealed piping, piping under a floor slab, piping in a crawl space of less than 24 inches in height, or piping in a plenum shall be extended through and terminated flush with finished wall, floor, or ground surface.
- C. Horizontal drains within a building shall be provided with cleanouts located not more than 100 feet apart. Cleanouts shall also be provided at every change of direction greater than 45 degrees. Where more than one change of direction occurs in a run of piping, only one cleanout shall be provided for every 40 feet of developed length of piping.
- D. Access doors and frames for cleanouts located behind walls shall be furnished by plumbing contractor and installed by others. A complete list of wall cleanout locations and associated access panels shall be prepared by the plumbing contractor prior to the erection of walls.

E. Manufacturer and Model

<u>Location</u>	<u>Zurn</u>	<u>J.R. Smith</u>	<u>Josam</u>
<u>Unfinished Areas</u>			
Walls	ZB-1441	4402-PB	558600-CO
Floors	ZB-1402	SQ-4-1388	57000-Z-CI
<u>Finished Floors</u>			
Terrazzo	ZN-1400-Z	4020-PB	57000-2
Carpet	ZN-1400-CM	4020-PB-Y	57000-14
Ceramic Tile	ZN-1400-TX	4020-PB-S	57000-2
Vinyl Floor Covering	ZN-1400-X	4020-BP-S	57000-Z-12
<u>Finished Walls</u>			
Plaster	ZN-1446	4530-Y	586000-COT
Tile	ZN-1446	4530-Y	
<u>Exposed Piping</u>			
Vertical	ZN-1440	4400	58910

2.2 ELEVATOR PIT SUMP PUMP

A. Provide simplex submersible elevator pipe sump pump, valves, piping, oil minder controls, and associated appurtenances. Pump shall function automatically and shall provide an alarm and separate LED lights for:

1. Presence of oil in the sump
2. High liquid in the sump
3. High amps or locked rotor condition
4. Power
5. Pump run function
6. High amps or locked rotor condition

B. Pump construction shall be ceramic face with heat resistant stainless steel and Buna-N components. Case shall be heavy duty close grain, high density cast iron with stainless steel strainer.

C. Pump shall be 1/2 HP, 3600 RPM, 120 volt, single phase, approved to UL 778 standards, hermetically sealed starter motor with built in overload protection, Class F insulation, air filled submersible pump rated at 50 gpm @ 20 ft/hd. Pump end bell motor and shell shall be cast iron, with stainless steel shaft, factory sealed grease lubricated ball bearings, mechanical seal, and perforated stainless steel plated strainer.

D. The main control shall be approved to UL 508 standards and housed in a gasketed NEMA 4X enclosure with see through window for observation of functions. The control shall be equipped

with an 8-pin twist lock receptacle, dual solid state Oil-Minder relays with variable sensitivity settings, an over current relay, self cleaning stainless steel sensor probe, high decibel warning horn with alarm silencing switch, dual floats, clearly marked terminal board and remote monitoring contact. The control unit, junction box, pump, floats and sensors shall be factory assembled and tested as a complete assembly. The main control shall be located outside of

the elevator shaft to permit monitoring of all functions without having to enter the elevator shaft.

E. Manufacturer and Model

1. Stancor – Model 50-E

PART 3 – EXECUTION (Not Used)

END OF SECTION 221319

SECTION 221413 - STORM DRAINAGE PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 PIPING SYSTEM STANDARDS OF MATERIALS

- A. Storm systems which are provided to serve HVAC equipment, components, and associated appurtenances shall be located within five feet of equipment drain point. Plumbing contractor shall coordinate exact locations of HVAC drain points with Mechanical Contractor prior to rough-in of indirect waste drains. HVAC equipment, components, and associated appurtenances shall be provided under the HVAC section.
- B. Each pipe length shall have the manufacturer's name cast, stamped, or rolled on.
- C. Each fitting shall have the manufacturer's symbol and pressure rating cast, stamped, or rolled on.

1.3 SUMMARY

- A. This section includes the following:
 - 1. Storm piping – Interior, above grade
 - 2. Storm piping – Below grade
 - 3. Emergency storm piping – Interior
 - 4. Installation and Testing

PART 2 – PRODUCTS

2.1 PIPING AND FITTINGS MATERIAL SCHEDULE

- A. Piping systems shall be constructed of the following materials, subject to approval by authorities having jurisdiction.
 - 1. Storm (ST) Piping – Above grade
 - Pipe: No-hub Cast Iron – ASTM A74, ASTM A888, CISPI 301 and be marked with the collective material trade mark of the Cast Iron Soil and Pipe Institute
 - Fittings: No-hub Cast Iron drainage – ASME B16.4, ASTM B16.12, ASTM A74, ASTM A888, CISPI 301
 - Joints: 4 inches and smaller – Cast iron neoprene gasket with heavy duty stainless steel coupling and four stainless steel bands
5 inches to 10 inches – Cast Iron neoprene gasket with heavy duty stainless steel coupling and six stainless steel bands

Pipe Manufacturer: Tyler Pipe; Charlotte Pipe
 Coupling Manufacturer: Mission Heavy Weight; Husky 4000
 Remark: Any portion of a storm piping system located above food service preparation areas or areas associated with food sales shall be provided with a secondary means of containment in the event of a leak. Provide in accordance with manufacturers requirements.

2. Storm (ST) Piping System – Below Grade

Pipe: Service weight hub and spigot Cast Iron – ASTM A74, ASTM A888, CISPI 301 and be marked with the collective material trade mark of the Cast Iron Soil and Pipe Institute
 Fittings: Cast Iron hub and spigot – ASTM A74, ASTM A888, CISPI 301
 Solder: Rubber compression gaskets – ASTM C564
 Manufacturer: Tyler Pipe; Charlotte Pipe
 Remark: Provide in accordance with manufacturers requirements

3. Emergency Storm (EST) Piping – Interior

Pipe: No-hub Cast Iron – ASTM A74, ASTM A888, CISPI 301 and be marked with the collective material trade mark of the Cast Iron Soil and Pipe Institute
 Fittings: No-hub Cast Iron drainage – ASME B16.4, ASTM B16.12, ASTM A74, ASTM A888, CISPI 301
 Joints: 4 inches and smaller – cast iron neoprene gasket with heavy duty stainless steel coupling and four stainless steel bands
 5 inches to 10 inches – Cast Iron neoprene gasket with heavy duty stainless steel coupling and six stainless steel bands
 Pipe Manufacturer: Tyler Pipe; Charlotte Pipe
 Coupling Manufacturer: Mission Heavy Weight; Husky 4000
 Remark: Any portion of emergency storm piping system located above food service preparation areas or areas associated with food sales shall be provided with a secondary means of containment in the event of a leak. Provide in accordance with manufacturers requirements.

2.2 PLUMBING PIPING SYSTEM PRESSURE CLASSIFICATION

A. Piping, fittings, and components, for the storm and emergency storm piping systems shall be capable of with standing the following:

Plumbing Piping System	Minimum Working Pressure
------------------------	--------------------------

Storm	10 foot head of water
Emergency storm	10 foot head of water

PART 3 – EXECUTION

3.1 GENERAL

- A. Provide provision for expansion and contraction in the piping systems, to prevent undue stress or strain on piping, building anchor points, and connected equipment.
- B. Piping passing through roof construction shall be arranged to provide a minimum of 12 inch clearance from walls or other obstructions so as to permit proper flashing. Set pipe flashing fittings at a suitable level above the roof to permit proper termination of flashing.

3.2 INSTALLATION AND TESTING

A. Installation Procedures

- 1. Slope of horizontal piping
 - a. Storm and emergency storm piping 3 inches to 6 inches shall be sloped at a minimum pitch of 1/8 inch per foot in direction of flow.
 - b. Storm piping 8 inches or larger shall be sloped at a minimum pitch of 1/16 inch per foot.
- 2. Branch drainage connections to stacks or main drains shall be made in a manner that shall not permit backflow.
- 3. Provide test tees in vertical risers as required to permit testing in sections.
- 4. Pipe shall have the cutting burrs and sharp edges reamed out.

B. System Testing

- 1. The entire storm and emergency storm system piping system shall be subjected to testing in accordance with applicable codes. Plumbing contractor shall provide all equipment, material, labor and associated appurtenances necessary for drainage system testing.
- 2. The storm and emergency storm piping systems shall be provided with two separate tests. The first test shall occur during the installation and the final test shall occur after the plumbing fixtures have been set and their traps filled with water. The entire drainage system shall be submitted to the final test.
- 3. Storm and emergency storm piping systems testing during construction shall be provided by utilizing either water or air.
 - a. Water Test
 - 1) A water test shall be applied to storm and emergency storm piping system either in its entirety or in sections. If applied to the entire system, all openings in the piping system shall be tightly closed, except the highest opening, and the system shall be filled to the point of overflow. If the system is tested in

sections, each opening shall be tightly plugged except the highest openings of the section under test. The section shall be filled with no less than a 10 foot head of water.

- 2) The water shall be kept in the system, or in a portion under test, for at least 15 minutes before inspection starts.
- 3) In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested so that no joint or pipe in the building, except for the uppermost 10 feet of the system, shall have been submitted to a test of not less than a 10 foot head of water.

b. Air Test

- 1) An air test shall be applied to storm and emergency storm piping system either in its entirety or in sections. All openings in the piping system shall be tightly closed and the system shall be filled with air until there is a uniform gauge pressure of 5 pounds per square inch or a pressure sufficient to balance a 10 inch column of mercury.
- 2) This pressure shall be held for a period of at least 15 minutes. Any adjustment to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period.

C. Video / Audio Pipe Inspection

1. Plumbing contractor shall coordinate periodic video / audio inspection of interior and below grade storm piping, storm risers, emergency storm piping, emergency storm risers, and other portions of the drainage system as requested by the Owner. At a minimum, periodic video / audio inspections shall occur as follows:
 - a. After all below grade storm piping is installed and tested but prior to pouring of concrete floor.
 - b. After all below grade storm piping is installed and concrete floor is poured.
 - c. After final topping of concrete and / or final grouting of floor
 - d. Storm and emergency storm piping and risers that will be concealed in shafts, chases, walls, etc., at the end of the project.
 - e. At the end of the project prior to turnover to turn over to Owner.
2. Video / audio inspection shall include alpha-numeric data on the image indicating date, time, and pipe identification.
3. Plumbing contractor shall:
 - a. Provide removal of cleanouts, plumbing fixture, or traps as required for camera access into drainage system and replace after inspection.
 - b. Provide removal of obstructions encountered in the storm and emergency storm drainage system during inspection in their entirety. Any demolition of roofs, walls, floors, landscape, or other building components associated with removal of obstruction shall be replaced to match conditions prior to demolition.
 - c. Provide documentation of video / audio camera inspection locations on contractors

As-Built floor plans and riser diagrams.

4. During video / audio inspection, if any portion of the drainage system is found not to be installed with the proper slope in accordance with the Plumbing Code, the Plumbing Contractor shall replace piping, fittings, and appurtenances as required to ensure proper operation of entire drainage system.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL

- A. Provide storm and emergency storm piping specialties as shown on drawings and as specified herein.

1.3 CLEANOUTS

- A. Provide cleanouts as required by local codes and authorities, as shown on the drawings, and as specified herein.

1.4 SUMMARY

- A. This section includes the following:
 - 1. Cleanouts

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Cleanouts shall be full size of pipe up to 4 inches, and shall be 4 inches for larger sizes. Cleanouts on piping 6 inches and smaller shall be provided with a clearance of not less than 18 inches for rodding. Cleanouts on piping 8 inches and larger shall be provided with a clearance of not less than 36 inches for rodding.
- B. Cleanouts on concealed piping, piping under a floor slab, piping in a crawl space of less than 24 inches in height, or piping in a plenum shall be extended through and terminated flush with finished wall, floor, or ground surface.
- C. Horizontal drains within a building shall be provided with cleanouts located not more than 100 feet apart. Cleanouts shall also be provided at every change of direction greater than 45 degrees. Where more than one change of direction occurs in a run of piping, only one cleanout shall be provided for every 40 feet of developed length of piping.
- D. Building storm sewers shall be provided with cleanout located not more than 100 feet apart measured from the upstream entrance of the cleanout. For building sewers 8 inches and larger, manholes shall be provided and located at each change of direction and at intervals of not more than 400 feet.
- E. Access doors and frames for cleanouts located behind walls shall be furnished by plumbing contractor and installed by others. A complete list of wall cleanout locations and associated access panels shall be prepared by the plumbing contractor prior to the erection of walls.

F. Manufacturer and Model

Location	Zurn	J.R. Smith	Josam
<u>Unfinished Areas</u>			
Walls	ZB-1441	4402-PC	558600-CO
Floors	ZB-1400	4020-PB	57000-Z-CI
<u>Finished Floors</u>			
Terrazzo	ZN-1400-Z	4020-PB	57000-2
Carpet	ZN-1400-CM	4020-PB-Y	57000-14
Ceramic Tile	ZN-1400-TX	4020-PB-S	57000-2
Resilient Flooring	ZN-1400-X	4020-BP-S	57000-Z-12
<u>Finished Walls</u>			
Gypboard, Tile, Plaster	ZN-1446	4530-Y	586000-COT
<u>Exposed Piping</u>			
Vertical	ZN-1440	4400	58910

PART 3 – EXECUTION (NOT USED)

A. END OF SECTION 221423

SECTION 224200 - COMMERCIAL PLUMBING FIXTURES AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General provisions of the Contract, Including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL

- A. Provided sink trap as indicated on drawings and as specified herein.
- B. Provide sink supply pipes as indicated on drawings and as specified herein.
- C. Provide plumbing fixtures as indicated on the drawings and specified herein.
- D. Provide ASSE 1070 complaint thermostatic mixing valve for all hand wash lavatories and sinks. One thermostatic mixing valve shall be provided for a group of 6 lavatories maximum, based on the mixing valve flow chart.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Traps
 - 2. Supply Pipes
 - 3. Plumbing Fixtures
 - 4. Floor Drains
 - 5. Roof Drains

PART 2 – PRODUCTS

1. TRAPS

- A. For sinks with 1 ¼ inch drain openings that are not provided with traps, provide an adjustable chrome-plated P-trap. P-Traps shall be 1 ¼ inch x 1 ½ inch, 17 gauge tubing outlet with cleanout plug, wall flange, and slip joint inlet.
 - 1. Manufacturer and Model
 - a. Zurn – Model Z8701-PC and no others
- B. For sinks with 1 ½ inch drain openings that are not provided with traps, provide an adjustable chrome-plated P-trap. P-Traps shall be 1 ½ inch x 1 ½ inch, 17 gauge tubing outlet with cleanout plug, wall flange, and slip joint inlet.
 - 1. Manufacturer and Model
 - a. Zurn – Model Z8702-PC and no others
- C. Exposed piping, fittings, escutcheons, valves, etc. shall be chrome-plated brass.

2.2 SUPPLY PIPES

- A. Supply pipes for sinks shall be 1/2 inch IPS x 3/8 inch O.D. angle valve with loose key handle, flexible tubing, cast brass escutcheon with set screw.
 - 1. Manufacturer and Model
 - a. Zurn – Model Z8802LRLK-PC and no others

2.3 PLUMBING FIXTURES

- A. Plumbing Fixtures
 - 1. Water Closet, WC-1 (Wall Mounted)

Water closet system shall be 1.28 gallon per flush vitreous china wall-hung water closet, with 1-1/2" top spud, 2-1/8" fully glazed trap way, siphon jet action, and exposed high efficiency flushometer valve. Flushometer shall be operated by an infrared convergence-type proximity sensor with smart technology, powered by a single 9 volt battery, furnished with a vandal resistant chrome plated cast brass valve body, chloramine resistant internal seals, manual over ride button and reversible cover. System shall be provided with high pressure vacuum breaker, one piece hex coupling nut, adjustable tailpiece, spud coupling and flange for top spud connection. Control stop has internal siphon-guard protection, vandal resistant stop cap, sweat solder kit and a cast wall flange with set screw.

 - a. Manufacturer and Model (Water Closet)
 - 1) Zurn - Model Z5615 and no others
 - b. Manufacturer and Model (Flush Valve – Sensor Battery Operated)
 - 1) Zurn - ZTS6200EV and no others
 - c. Manufacturer and Model (Toilet Seat)
 - 1) Zurn – Model Z5955SS-EL and no others
 - 2. Handicapped Water Closet, WC-2 (Wall Mounted)

Handicapped water closet system shall be 1.28 gallon per flush vitreous china wall- hung water closet, with 1-1/2" top spud, 2-1/8" fully glazed trap way, siphon jet action, and exposed high efficiency flushometer valve. Flushometer shall be operated by an infrared convergence-type proximity sensor with smart technology, powered by a single 9 volt battery, furnished with a vandal resistant chrome plated cast brass valve body, chloramine resistant internal seals, manual over ride button and reversible cover. System shall be provided with high pressure vacuum breaker, one piece hex coupling nut, adjustable tailpiece, spud coupling and flange for top spud connection. Control stop has internal siphon-guard protection, vandal resistant stop cap, sweat solder kit and a cast wall flange with set screw. Mounting height shall be as indicated on Architectural drawings.

 - a. Manufacturer and Model (Water Closet)
 - 1) Zurn - Model Z5615 and no others
 - b. Manufacturer and Model (Flush Valve – Sensor Battery Operated)

- 1) Zurn - ZTS6200EV and no others c.

Manufacturer and Model (Toilet Seat)

- 1) Zurn – Model Z5955SS-EL and no others

3. Urinal U-1 (Wall Mounted)

Urinal system shall 1/8th gallon per flush vitreous china wall-hung urinal, with 3/4" top spud, 2" fully glazed trap way, wash down action, and exposed high efficiency flushometer valve. Flushometer shall be operated by an infrared convergence-type proximity sensor with smart technology, powered by a single 4 "AA" batteries, furnished with a vandal resistant chrome plated cast brass valve body, chloramine resistant internal seals, and manual over ride button. System shall be provided with high pressure vacuum breaker, one piece hex coupling nut, adjustable tailpiece, spud coupling and flange for top spud connection. Control stop has internal siphon-guard protection, vandal resistant stop cap, sweat solder kit and a cast wall flange with set screw.

a. Manufacturer and Model (Urinal)

- 1) Zurn – Model Z5738.205.00 and no others

4. Handicapped Urinal U-2 (Wall Mounted)

Urinal system shall 1/8th gallon per flush vitreous china wall-hung urinal, with 3/4" top spud, 2" fully glazed trap way, wash down action, and exposed high efficiency flushometer valve. Flushometer shall be operated by an infrared convergence-type proximity sensor with smart technology, powered by a single 4 "AA" batteries, furnished with a vandal resistant chrome plated cast brass valve body, chloramine resistant internal seals, and manual over ride button. System shall be provided with high pressure vacuum breaker, one piece hex coupling nut, adjustable tailpiece, spud coupling and flange for top spud connection. Control stop has internal siphon-guard protection, vandal resistant stop cap, sweat solder kit and a cast wall flange with set screw. Mounting height shall be as indicated on Architectural drawings.

a. Manufacturer and Model (Urinal)

- 1) Zurn – Model Z5738.205.00 and no others

5. Sink, L-1 (Countertop – Under-mount - Lavatory)

Stainless steel seamlessly formed 18 gauge type 304 sink, front over flow, sound guard undercoating, 5-15/16" deep.

a. Manufacturer and Model (Sink)

- 1) Elkay – Model ELUH1812
- 2) Just
- 3) Moen

b. Manufacturer and Model (Faucet – Hand Operated)

- 1) Moen – Model 8810 with ½ gpm aerator Model 16350

c. Manufacturer and Model (Drain)

- 1) McGuire – Model 155A
- 2) Zurn

- 3) BrassCraft
6. Sink, S-1 (Countertop - WorkRoom)
Single compartment 18 gauge, Type 302 nickel bearing stainless steel self-rim sink. Sink shall be seamlessly drawn, with undercoated underside. Compartment and deck shall be recessed 3/16 inch below outside edge of sink. Provide with 3-1/2 inch drain opening and basket strainer and three 1-1/2 inch diameter hole for faucet.
 - a. Manufacturer and Model (Sink)
 - 1) Elkay – Model LR2219 8” deep
 - 2) Advance Tabco
 - 3) Just
 - b. Manufacturer and Model (Faucet –Hand Operated)
 - 1) Chicago Faucet – Model 201-AGN8AE3-317CP
 - c. Manufacturer and Model (Drain)
 - 1) McGuire – Model 151
 - 2) Zurn
 - 3) BrassCraft
7. Electric Water Cooler, EWC-1 (Bi-Level – Recess Mounted)
Self contained, bi-level recess mounted electric refrigerated water cooler with self closing push bars on front. Provide with stainless steel finish and stainless steel bubbler.
 - a. Manufacturer and Model (Water Cooler)
 - 1) Halsey Taylor – Model OVL-II SER-Q
 - 2) Haws– Model H1011.8
 - 3) Elkay – Model ERPBM28K
 - b. Manufacturer and Model (Drain)
 - 1) Zurn – Model Z8701-9B-PC and no others
8. Wall Hydrant, WH-1 (Non-freeze)
Exposed, anti-siphon, non-freeze, automatic draining wall hydrant with integral backflow preventer.
 - a. Manufacturer and Model
 - 1) Zurn – Model Z1310-WC and no others
9. Hose Bibb, HB-1 (Interior)
Exposed, interior anti-siphon, wall hydrant with vacuum breaker spout.
 - a. Manufacturer and Model
 - 1) Watts – Model SC8-3
 - 2) Nibco
 - 3) Sioux Chief
10. Roof Hydrant, RH-1

Exposed, Non-freeze. Provide dual check valve on water piping connection.

- a. Manufacturer and Model
 - 1) Zurn Z1388 and no others.

- 11. Mop Basin, MB-1 (Floor Mounted)
Terrazzo mop basin, 24 x 24 x 12 inches with, integral drain, stainless steel caps on all curbs, and stainless steel wall guards.

- a. Manufacturer and Model (Mop Basin)
 - 1) Fiat Products – Model TSB-100
 - 2) Stern Williams – Model SB-903
 - 3) Acorn – Model TSH-24-SSC
- b. Manufacturer and Model (Faucet and Accessories)
 - 1) Zurn – Model Z841L1-RC and no others

B. Fixture Supports

- 1. Wall-mounted water closet supports shall be adjustable siphon jet complete with cast iron right hand, left hand, or double main fitting, with adjustable gasketed face plate, universal floor mounted foot supports, corrosion resistant adjustable ABS coupling with integral test cap, fixture bolts, trim, and stud protectors.
 - a. Manufacturer and Model (Single - Horizontal)
 - 1) Zurn – Model Z-1203-N Series and no others
 - b. Manufacturer and Model (Back-to-Back - Horizontal)
 - 1) Zurn – Model Z-1203-ND Series and no others
 - c. Manufacturer and Model (Single – Vertical)
 - 1) Zurn – Model Z-1204-N Series and no others.
 - d. Manufacturer and Model (Back-to-Back – Vertical)
 - 1) Zurn – Model Z-1204-ND Series and no others
- 2. Wall-mounted urinal shall be rectangular steel uprights with welded feet, adjustable face plate, upper support plate, adjustable corrosion resistant coupling, fixture bolts, trim, and bonded gasket.
 - a. Manufacturer and Model
 - 1) Zurn – Model Z1222 and no others

C. Handicapped Plumbing Fixtures

1. Provide P-trap, hot water angle valves and supply tubing, and cold water angle valves and supply tubing, with insulation in accordance with the American with Disabilities Act (ADA).

2.4 FLOOR DRAINS

A. Floor Drains FD-1

Cast iron body with bottom outlet, trap primer connection, combination membrane clamp and adjustable collar with strainer.

1. Manufacturer and Model
 - a. Zurn – Model Z415-P with Type B Strainer and no others

B. Floor Drains FD-2,3

Cast iron body with bottom outlet, seepage pan, combination membrane clamp and cast iron slotted grate.

1. Manufacturer and Model
 - a. Zurn – Model Z550-P and no others

C. All floor drain shall be provided with deep seal traps.

2.5 ROOF DRAINS

A. Roof Drain RD-1,2

Combination primary and emergency roof drain system. 15 inch diameter with cast iron body, roof sump receiver, under deck clamp, adjustable extension, and combination membrane flashing clamp/gravel guard.

1. Manufacturer and Model
 - a. Zurn – Model Z-163 and no others

B. Secondary Roof Drain Down Spout Nozzle DS-1

Secondary roof drain down spout nozzle with nickel bronze body, threaded inlet, stainless steel screen, and decorative face of wall flange and outlet nozzle.

1. Use for emergency discharge through exterior walls were noted on plans
2. Manufacturer and Model
 - a. Zurn – Model ZANB199-SS and no others

2.6 TRENCH DRAINS

A. Trench Drain TD-1

Mea-Josam trench drain constructed of polymer concrete with galvanized steel protected edges, 4" interior width, non sloped, and 4" bottom outlet. Provide 1000 series starfix grate.

1. Manufacturer and Model

- a. Josam – Model LZ-1000 and no others. Provide MEA-Josam galvanized steel mesh grate series 140132 with starfix securing feature and class B load rating.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide plumbing fixtures in a secure, true, plumb and symmetrical manner. Thoroughly clean each fixture after installation and leave in proper working order, absolutely solid in their respective positions. For sinks and lavatories, verify clockwise rotation for cold water stem and counterclockwise rotation for hot water stem while facing respective stems.
- B. Water supply piping serving flush valves for water closets, urinals and associated accessories shall be securely anchored within the construction at each exit point to ensure that flush valves, equipment and accessories shall be absolutely rigid with no movement in supply pipes.
- C. When fixture trim is completed, adjust stops to provide proper flow through each valve or faucet.
- D. Each fixture shall be filled with water and checked for leaks and retarded drainage.
- E. Flush valves, loose key or wheel handle stops, valves and similar devices shall be adjusted and balanced to provide first class operation of the various systems.
- F. Floor-mounted fixtures shall not be installed until finished floor is in place.
- G. Where any plumbing fixture comes in contact with the wall, seal with a non-shrink, mildew-resistant caulking.
- H. Provide waterproofing of floor drains as required by local codes. Flashing material shall extend a minimum of 18 inches from the center of the floor drain in all directions.
- I. Installation of handicapped plumbing fixtures shall meet requirements of Americans with Disabilities Act.
- J. Provide final connection and install fixtures and equipment furnished by others.

END OF SECTION 224200

SECTION 230000 - GENERAL HVAC PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Scope of Work.
 - 2. Intent of Drawings.
 - 3. Definitions.
 - 4. General Standards of Materials.
 - 5. Applicable Codes.
 - 6. Guarantees and Certificates.
 - 7. Quiet Operation and Vibration Control.
 - 8. Coordination.
 - 9. Shop Drawings, Product Data, and Samples.
 - 10. Owner Instruction.
 - 11. Sustainable Design Requirements
 - 12. Class I and Class II Substances.
 - 13. Temporary Conditioning and Starting of Equipment.

1.3 SCOPE OF WORK

- A. The scope of the work included under Division 23 of the specifications shall include complete systems as shown in the Contract Documents and specified herein. Any work reasonably inferable or required to result in a complete installation or the intended operation and performance of the systems, shall be included in the Base Bid except where there is specific reference to exclusion and incorporation in other quotations.
- B. A brief written Scope of Work appears in Division 1.

1.4 INTENT OF DRAWINGS

- A. Provide complete and functional systems for the project. The systems shall conform to the details stated in the specifications and shown on the drawings. Items or work not shown or specified, but required for complete systems, shall be provided and conform with accepted trade practices. The drawings and specifications are presented to define specific system requirements and serve to expand on the primary contract requirements of providing complete systems. The drawings are diagrammatic and indicate the general arrangement and routing of the systems included in this contractors work.
- B. Do not scale the drawings. Because of the scale of the drawings, it is not possible to indicate offsets, fittings, valves, or similar items which may be required to provide complete operating systems. Carefully investigate conditions affecting the work associated with this project. Install systems in such a manner that interferences between pipes, conduit, ducts, equipment, architectural and structural features are avoided. Provide items required to meet the project conditions without additional cost to the owner.

- C. These documents may not explicitly disclose final details required for a complete systems installation; however, contractors shall possess the expertise to include the necessary components in complete operating systems.
- D. Contractors shall be "Experienced" (as defined in Division 1) in this type of construction and realize the extent of the work required.

1.5 DEFINITIONS

- A. Specific terminology, as used herein, shall have the following meanings:
 - 1. "Furnish"...Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar subsequent requirements.
 - 2. "Install"...Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar requirements.
 - 3. "Provide"...Furnish and Install and shall include, without limitation, all labor, materials, equipment, transportation, services, and other items required for reasonably inferable to complete the referenced tasks.
 - 4. "Concealed, Interior"...Concealed from view and protected from physical contact by building occupants.
 - 5. "Concealed, Exterior" ...Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures.
 - 6. "Exposed, Interior"...Exposed to view indoors (not concealed).
 - 7. "Exposed, Exterior"...Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
 - 8. "Finished Space" ...Space other than mechanical rooms, electrical rooms, pipe chases, unheated spaces immediately below roof, space above finish ceilings, crawl spaces, utility service tunnels, and interstitial spaces.
 - 9. "Conditioned"...Spaces directly provided with heating and cooling.
 - 10. "Unconditioned"...Spaces without heating or cooling including ceiling plenums.
 - 11. "Indoors"...Located inside the exterior walls and roof of the building.
 - 12. "Outdoors"...Located outside the exterior walls and roof of the building.
 - 13. "Atmosphere"...The same as outdoors.

1.6 GENERAL STANDARDS OF MATERIALS

- A. Equipment and materials, unless otherwise noted, shall be new and of first quality, produced by manufacturers who have been regularly engaged in the manufacture of these products for a period of not less than five years.
- B. Equipment of one type shall be the products of one manufacturer; similar items of the same classification shall be identical, including equipment, assemblies, parts and components.
- C. Materials furnished shall be determined safe by a nationally recognized testing organization, such as Underwriters' Laboratories, Inc., or Factory Mutual Engineering Corporation, and materials shall be labeled, certified or listed by such organizations. Where third party

certification is required for packaged equipment, the equipment shall bear the appropriate certification label.

- D. With respect to custom made equipment or related installations which are constructed specially for this project, the manufacturer shall certify the safety of same on the basis of test data. The Owner shall be furnished copies of such certificates.

1.7 APPLICABLE CODES

- A. Materials furnished and work installed shall comply with applicable codes listed in Division 1, with the requirements of the local utility companies, and with the requirements of governmental departments or authorities having jurisdiction.

1.8 GUARANTEES AND CERTIFICATES

- A. Defective equipment, materials or workmanship, including damage to the work provided under other divisions of this contract, shall be replaced or repaired at no extra cost to the Owner for the duration of the stipulated guarantee periods.
 - 1. Unless specifically indicated otherwise, the duration of the guarantee period shall be one (1) year following the date of Substantial Completion. Temporary operation of the equipment for temporary conditioning, testing, etc., prior to occupancy will not be considered part of the warranty period.

1.9 QUIET OPERATION AND VIBRATION CONTROL

- A. Equipment and associated items shall operate under conditions of load without sound or vibration deemed objectionable by the Architect. In the case of moving equipment, sound or vibration noticeable outside of the room in which it is installed, or noticeable within the room in which it is installed, shall be deemed objectionable. Sound or vibration deemed objectionable shall be corrected in an approved manner at no extra cost to the Owner. Vibration control shall be provided by means of approved vibration isolators and installed in accordance with the isolator manufacturer's recommendations.
- B. The sound pressure levels around mechanical and electrical equipment (fans, pumps, motors, etc.) in equipment spaces shall not exceed 85 dBA at any point three (3) feet from the equipment, with all equipment in the room operating. The sound criteria applies to the complete range of each piece of equipment.

1.10 COORDINATION

- A. Coordinate and furnish in writing to the Architect information necessary to permit the work to be installed satisfactorily and with the least possible interference or delay.
- B. Coordinated drawings shall be prepared as defined in Division 1. No installation of permanent systems shall proceed until the coordinated drawings are reviewed by the Architect. No extra charges shall be allowed for changes required to accommodate the installations of systems provided under other divisions of this contract.
- C. Coordination drawings shall be developed from individual system shop drawings and contractor fabrication drawings. Electronic or other reproduced engineering design drawings used as coordination drawings are not acceptable.

- D. When work is installed without proper coordination, changes to this work deemed necessary by the Architect shall be made to correct the conditions without extra cost to the Owner.

1.11 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. Shop drawings, product data, and samples shall be submitted in accordance with the provisions of Division 1.
- B. The following shall be submitted by the Contractor for review:
 - 1. Scale shop drawings showing system components with sizing indicated, including but not limited to:
 - a. equipment locations.
 - b. piping and ductwork
 - c. insert and sleeve locations
 - d. hangers, anchors and guides
 - e. expansion joints and loops
 - f. access doors
 - 2. Product data for system components and materials (including construction standards).
 - 3. Samples of finishes and trim exposed to view, such as cleanout plates, fixture trim, escutcheon plates and similar items.

1.12 OWNER INSTRUCTION

- A. After final tests and adjustments have been completed, furnish the services of qualified personnel to instruct representatives of the Owner in the operation and maintenance procedures for equipment and systems installed as part of this project. Operation and maintenance instructions for major items of equipment shall be directly supervised by the equipment manufacturer's representative. Supply qualified personnel to operate equipment for sufficient length of time as required to meet governing authorities' operation and performance tests and as required to assure that the Owner's representatives are properly qualified to take over operation and maintenance procedures. Minimum instruction period shall be 80 man hours. The instruction period shall be broken into segments at the discretion of the Owner.
 - 1. Notify the Architect, the Owner's representative and equipment manufacturers' representatives, by letter, as to the time and date of operating and maintenance instruction periods approved by the Owner at least one (1) week prior to conducting same.
 - 2. Forward to the Architect the signatures of all those present for the instruction periods.
 - 3. Refer to division 1 for additional requirements.

1.13 Sustainable Design Requirements

- A. This project is going for LEED Gold Certification. Refer to section 018113 Sustainable Design Requirements for all contractor requirements and the individual points being attempted.
- B. Submittals shall be complete to indicate compliance with the LEED requirements that are required in the contract documents.

1.14 Commissioning Requirements

- A. This project will be commissioned by a third party commissioning agent.
- B. Refer to sections 019100, 019110, 230800, and 230810 for all commissioning requirements.

1.15 CLASS I AND CLASS II SUBSTANCES

- A. All equipment containing Class I or Class II substances as identified by the Clean Air Act of 1990 shall be manufactured in strict accordance with that act and its amendments.
- B. All work involving Class I or Class II substances as identified by the Clean Air Act of 1990 shall be performed in strict accordance with that act and its amendments.

1.16 TEMPORARY CONDITIONING AND STARTING OF EQUIPMENT

A. Temporary Conditioning

- 1. The building systems and central plants may be used by the general contractor for temporary conditioning only after approval is granted by the Architect and the Owner. If the systems are not ready to be used when needed, the General Contractor shall provide temporary systems for conditioning the building.
- 2. The Science Center primary isolation valve shall remain closed until temporary cooling is authorized.
- 3. The chilled water / hot water energy meters must be calibrated and operation to record the energy used by the General Contractor. The GC is responsible for this cost, which will be determined by the owner.
- 4. Prior to authorization for temporary conditioning (starting the AHU) the following must be completed by the general contractor and witnessed by the owner and architect.
 - a. The air handling units shall be thoroughly cleaned.
 - b. Return ductwork openings and return grilles shall be covered by temporary filters

B. Starting of Equipment

- 1. Flushing of equipment shall not commence until approval by the College and the Architect is provided to the General Contractor in writing. If flushing or pumps are started prior to approval, all of the coils in the system that was flushed must be removed and replaced with new coils and the process must start over from the beginning.
- 2. Before flushing can commence and the pumps are started for the first time, all coil isolation valves shall be closed and the flushing bypass isolation valves shall be opened. In addition, all required pipe cleaning prior to flushing shall have been completed.

3. During the flushing process, the start-up strainer in the suction diffuser shall be monitored and cleaned regularly.
4. A sub micron sand filter shall be installed exterior to the building at the end of the primary run of piping for each phase of the site piping. The contractor is responsible for renting or purchasing the sand filter.
5. Coil isolation valves shall not be opened until written permission is granted by the Owner and the Architect. The system flush shall continue for a minimum of 24 hours. The flushing bypass lines shall be closed by the mechanical contractor and verified by the general contractor.
6. The new work shall then finally be connected to the existing plants once the final site tie in is complete and final permission is given in writing by the owner and the architect.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 230000

SECTION 230500 - COMMON WORK FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

This Section includes the following:

- Demolition.
- Cutting and Patching.
- Waterproofing.
- Air Plenums.
- Electrical Connections.
- Accessibility.
- Painting.
- Equipment Foundations, Supports, Piers, and Attachments.
- Equipment Guards and Rails.
- Cleaning, Protection and Adjustment.
- Special Tools.
- Welding.
- As built equipment, valve, and component locations identifiers
- Building Pipe Expansion

1.3 DEMOLITION

- A. Review the construction documents, to determine the affected areas of the existing structure. Remove systems in the affected areas not to be reused including equipment, piping, ductwork, controls, hangers, supports, etc.
- B. Schedule demolition work with Owner.
- C. Demolition work involving electrical systems shall be coordinated prior to commencement of demolition work.
- D. All existing piping shall be saw-cut, not broken, at point where piping connects to existing.
- E. Where demolition of existing piping, ductwork, and other mechanical equipment, all such service shall be properly terminated in an approved manner to allow affected systems to remain in operation.
- F. When demolishing existing equipment, all control wiring or pneumatic tubing serving that equipment shall be properly terminated in an approved manner to allow affected systems to remain in operation. Remove pneumatic tubing back to risers and plug.
- G. Where systems serve areas under construction and areas not affected by the construction, all return air and exhaust air terminals in the construction area shall be capped, and fans shall be rebalanced for new air quantities.

- H. The Owner has the right-of-first-refusal for any items to be demolished, salvaged or removed. The Contractor and Owner shall jointly review the space where demolition is to occur and identify items the Owner elects to retain prior to demolition and removal. Remove items to be retained by the Owner and deliver them to the location directed by the Owner within a (5) five mile radius of the project. Promptly remove and properly dispose of materials, equipment, ductwork, piping, debris, etc., which is not specified for reuse, storage, or retainage by Owner.
- I. Provide support as required for any existing piping and equipment support affected by demolition.
- J. Provide cutting and patching to match existing finish of roof, wall, floor, etc., required for demolition of existing systems. Fire and smoke ratings compromised due to demolition shall be immediately restored. Repair or apply fire proofing to structural components that are exposed due to demolition, unless noted otherwise.
- K. Where piping, ductwork, etc., serves area affected by demolition and other areas of building not affected by demolition, reconnect piping, ductwork, etc., serving unaffected areas to existing or new systems serving affected areas.

1.4 CUTTING AND PATCHING

- A. Provide cutting and patching necessary to install the work specified herein. Patching shall match adjacent surfaces. Refer to Division 1 - Cutting and Patching for specific directions.
- B. No structural members shall be cut without prior approval of the Architect.
- C. Provide ceiling removal and replacement where work above ceilings is required. Replace ceiling components damaged in the process.

1.5 WATERPROOFING

- A. Where work pierces waterproofing, including waterproof concrete, the method of installation shall be approved by the Architect prior to performing the work. Furnish necessary sleeves, caulking and flashing required to make openings absolutely watertight.

1.6 AIR PLENUMS

- A. In plenums which are used as part of an air distribution system as defined by NFPA , materials must be of the type rated for air plenum use. The Contractor shall be responsible to utilize the correct materials in ceiling space used for environmental air purposes.

1.7 ELECTRICAL CONNECTIONS

- A. Regardless of voltage, provide control wiring, interlock wiring, and equipment control wiring for the equipment provided under this division of the specifications.
- B. Furnish electrical disconnect switches, starters and combination starter disconnects required for equipment provided under this division of the specifications. Circuit breakers furnished shall be rated for motor protection.
- C. Power wiring not used for control functions, complete from power source to motor or equipment junction box, including power wiring through starters, shall be provided under Division 26.

- D. Coordinate to ensure that electrical devices furnished or provided are compatible with the electrical systems used.

1.8 ACCESSIBILITY

- A. Coordinate to ensure the sufficiency of the size of shafts, and chases, and the adequacy of clearances in hung ceilings and other areas required for the proper installation of this work.
- B. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Locations in ceilings requiring access shall be coordinated with, but not limited to lights, curtain tracks, speakers, etc. Equipment requiring access shall include, but is not necessarily limited to, valves, traps, clean-outs, motors, fire dampers, controllers, switchgear, drain points, etc.
- C. Furnish access doors under this division for installation by General Contractor. Coordinate during bidding phase with General Contractor. All dampers, valves, sensors, and equipment shall be accessible for inspection and repair. Provide access doors of sufficient size where required to maintain this level of accessibility.
- D. Indicate the locations of access doors for each concealed valve, control, damper, or other device concealed behind finished construction and requiring service on the coordination drawings. Equipment below floor slab or finished grade shall also be indicated on the coordinating drawings.

1.9 PAINTING

- A. Painting requirements of this section shall conform to Division 9 – Painting.
- B. Provide surface preparation, priming, and final coat application in strict accordance with manufacturer's recommendations.
- C. Provide field painting of all piping, hangers, supports, equipment platforms, railings, and miscellaneous metals located outdoors (including galvanized jacketed piping and insulated piping).

1.10 EQUIPMENT FOUNDATIONS, SUPPORTS, PIERS AND ATTACHMENTS

- A. Provide necessary foundations, auxiliary steel, supports, pads, bases and piers required for equipment specified in this division; submit drawings in accordance with Shop Drawing Submittal requirements prior to the purchase, fabrication or construction of same.
- B. Provide 4 inch thick concrete pads for boilers, chillers, compressors, base-mounted pumps, rotating equipment, and floor-mounted equipment located in equipment rooms and as indicated on drawings. Pads shall be extended 6 inches beyond machine base in each direction with top edge chamfered. Anchor equipment pads to the floor in accordance with latest building codes seismic requirements.
- C. Construction of foundations, supports, and pads where mounted on the floor, shall be of the same materials and same quality of finish as the adjacent and surrounding floor material.
- D. Equipment shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Architect, deemed insufficient shall be replaced as directed, with no additional cost to the Owner.

1.11 EQUIPMENT GUARDS AND RAILS

- A. Provide readily removable guards or railings for belt drives and rotating machinery. Guards shall consist of heavy angle iron frames, hinged and latched, with heavy galvanized iron crimped mesh wire securely fastened to frames. Railing shall be 1-1/2 inch pipe and railing fittings.
- B. Multiple V-belt drives shall have band belts to minimize vibration.

1.12 CLEANING, PROTECTION AND ADJUSTMENT

A. Cleaning:

- 1. General cleaning requirements are specified in Division 1.
- 2. Upon completion of the work, clean the exterior surface of equipment, accessories, and trim installed. Clean, polish, and leave equipment, accessories, and trim in first-class condition.

B. Protection of Surfaces:

- 1. Protect new and existing surfaces from damage during the construction period.
- 2. Provide plywood or similar material under equipment or materials stored on floors or roofs. Provide protection in areas where construction may damage surfaces.
- 3. Surfaces damaged during the construction shall be repaired or replaced at the cost of the Contractor at fault. The method of repairing or replacing the surface shall be approved by the Owner and Architect

C. Protection of Services:

- 1. Protect new and existing services from damage during the construction period.
- 2. Repair, replace and maintain in service any new or existing utilities, facilities or services (underground, overground, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction.
- 3. Services damaged during the construction shall be replaced at the cost of the Contractor at fault. The method used in repairing, replacing or maintaining the services shall be approved by the Owner and Architect

D. Protection of Equipment and Materials:

- 1. Equipment and materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground and out of standing water by means of pallets or racks, and covered with tarpaulins.
- 2. Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and replacement if, in the opinion of the Architect or the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its

immediate use or performance is questionable, or that its normal life expectancy has been curtailed.

3. During the construction period, protect ductwork, piping and equipment from damage and dirt. Properly cap ductwork and piping. Each system of piping shall be flushed to remove grit, dirt, sand, and other foreign matter for as long a time as required to thoroughly clean the systems. The material shall be delivered to the site with the protection.
4. Provide three (3) complete sets of filters. One set shall be installed just prior to balancing but after cleaning of duct and air handling systems. The second shall be installed by the contractor on the day of building turn-over. The building flushing needs to be complete to satisfy the LEED requirement prior to the 2nd set of filters being installed. The third set of filters shall be turned over to Owner for future use. All filters should be stored off site in a protected area until just prior to the filters needing to be installed or turned over to the owner.
5. Should air handling systems be used for temporary heating during construction, provide temporary filters of the same efficiencies to those specified for permanent use. In addition to the two (2) permanent sets required above, temporary filters shall be replaced with additional temporary filters, as required, when the pressure drop is double the initial pressure drop rating of the filter.

E. Adjustment:

1. After the entire installation has been completed, make required adjustments to balancing valves, air vents, automatic controls, circulators, pressure reducing valves and similar devices until performance requirements are met.
2. Provide factory-lubricated bearings for mechanical equipment. Before initial startup of mechanical equipment, inspect and verify bearings for proper amounts of lubricant. If required, provide proper amounts of lubricant in accordance with manufacturer's recommendations.

1.13 SPECIAL TOOLS

- A. Provide the Owner's representative with two (2) sets of special tools required for operation and maintenance of equipment provided.

1.14 WELDING

A. General Requirements

1. This paragraph covers the welding of systems. Deviations from applicable codes, approved procedures and approved shop drawings shall not be permitted. Materials or components with welds made off the site shall not be accepted if the welding does not conform to the requirements of this specification.
2. The general contractor shall hire an independent 3rd party testing agency to test/certify 25% of all welds via scans (visual inspection is not permissible). The agency shall develop and formally submit the testing procedures prior to testing. If more than 5% of the welds tested fail the initial test, then 100% of all welds shall be tested. The general contractor shall bear all costs for the testing.

3. Certified welders, previously certified by test, may be accepted for the work without re-certification provided that all of the following conditions are fulfilled:
 - a. Submit copies of welder certification test records in accordance with this Division and Division 1 requirements.
 - b. Testing was performed by an independent testing laboratory.
 - c. The welding procedures and welders are certified in accordance with the "ASME Boiler and Pressure Vessel Code," and base materials, filler materials, electrodes, equipment, and processes conform to the applicable requirements of this specification.
 - d. Certification has been within a one (1) year period from the start of the project.
4. Filler metals, electrodes, fluxes and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to assure safe handling.
5. Submit welding certificates for review. Each welder assigned to work covered by this specification shall be certified by performance tests using equipment, positions, procedures, base metals, and electrodes or bare filler wires.
6. Before assigning welders to the work, provide the architect with their names, together with certification that each individual is certified as specified. No welding work shall start prior to submissions. The certification shall state the type of welding and positions for which each is certified, the code and procedure under which each is certified, date certified, and the firm and individual certifying the certified tests.
7. Each welder shall be assigned an identifying number, letter, or symbol that shall be used to identify his welds. A list of the welders' names and symbol for each shall be submitted. To identify welds, either written records indicating the location of welds made by each welder shall be submitted, or each welder shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 3 foot intervals. Identification by die stamps or electric etchers shall be confined to the weld reinforcing crown, preferably in the finished crater.

PART 2 - PRODUCTS

2.1 ACCESS DOORS

- A. Each access door assembly manufactured as an integral unit, complete with all parts and ready for installation.
- B. Access doors and frames shall be of continuous welded steel construction, unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
- C. Frames shall be fabricated from 16-gauge steel.

1. Fabricate frame with exposed flange nominal 1 inch wide around perimeter of frame for units installed in the following construction:
 - a. Exposed Masonry
 2. For gypsum drywall or veneer gypsum plaster, furnish perforated frames with drywall bead.
 3. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.
 4. For full-bed plaster applications, furnish frames with galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame
- D. Flush Panel Doors shall be fabricated from not less than 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175°. Finish with manufacturer's factory-applied prime paint.
1. For fire-rated units, provide manufacturer's standard insulated flush panel/doors, with continuous piano hinge and self-closing mechanism.
- E. Locking devices shall be flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.
- F. Manufacturers:
1. Bar-Co., Inc.
 2. J. L. Industries
 3. Karp Associates, Inc.
 4. Nystrom, Inc.
- 2.2 PIPING WELDING
- A. Welding materials shall comply with the "ASME Boiler and Pressure Vessel Code." Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a certified welder using qualified welding procedures.
- 2.3 Building Expansion Compensator
- A. Provide building expansion compensator as shown on plans.
 - B. Compensator shall be Twin City Hose V connectors or equivalent.

PART 3 - EXECUTION

3.1 ACCESS DOORS

- A. Coordinate installation of access doors with the General Contractor. Locations of access shall be submitted and doors furnished in sufficient time to allow installation in the normal course of the work.

3.2 WELDING

- A. Perform welding in accordance with qualified procedures using certified welders. Welding shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions. Welding of hangers, supports, and plates to structural members shall conform to AWS specifications.
- B. Testing welds as noted in Part 2.
- C. Field bevels and shop bevels shall be by mechanical means or by flame cutting. Where beveling is by flame cutting, thoroughly clean surfaces of scale and oxidation just prior to welding. Beveling shall conform to ANSI B31.1 and AWS B3.0.
- D. Replace and re-inspect defective welds. Repairing defective welds by adding weld material over the defect or by peening shall not be permitted. Welders responsible for defective welds must be re-certified.
- E. Store electrodes in a dry heated area, keep free of moisture and dampness during fabrication operations. Discard electrodes that have lost part of their coating.

3.3 AS BUILT EQUIPMENT, VALVE, AND COMPONENT LOCATION IDENTIFICATION

- A. The College does not want any ceiling markers used to identify equipment, valve, or other components requiring access that are located above a ceiling.
- B. In lieu of ceiling markers, the contractor shall create 8.5 x 11 or 11x17 sheets for each room and corridor indicating the components located above the ceiling that will need to be accessed.
 - 1. These include division 22 and 23 components.
 - 2. The list of components shall include all components requiring service including "VAV Boxes", control sensors, valves, trap primers, control devices, volume dampers, controllers, and other similar components.
 - 3. These sheets shall be provided on a CD as a pdf and as a hard copy in a "D" clip binder.
 - 4. In addition, a laminated sheet per room shall be fixed above the door to that room on the room side of the wall, above the ceiling.

3.4 Expansion Compensation

- A. Retain the services of a Registered Professional Engineer to provide the calculations and design for all HVAC piping Expansion Compensation, including but not limited to the anchors, guides, hangers and all expansion. The contractor is responsible to provide anchors, guides, hangers and expansion compensation whether shown on the drawings or not.

END OF SECTION 230500

SECTION 230513 - COMMON ELECTRICAL REQUIREMENTS FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Motors
 - 2. Enclosed Controllers (Starters, Combination Starter/Disconnects and Sentinel Switches)
 - 3. Enclosed Switches (Disconnects)
 - 4. Variable-Frequency Motor Controllers

1.3 DESCRIPTION

- A. Enclosed Controllers and Switches shall be furnished under this Division for motors provided. Controllers and Switches in motor control centers shall be provided under Division 26.
- B. This section does not apply to Controllers and Switches in a motor control center.

1.4 STANDARDS

- A. AC motor control shall conform to standards and references in NEMA MG 1 and UL.

PART 2 – PRODUCTS

2.1 MOTORS

- A. Provide motors for equipment specified in this Division.
- B. Motors for equipment shall be supplied by the equipment manufacturer. Motors shall be furnished with Enclosed Controllers, except motors with Controllers in a motor control center. Refer to electrical drawings for Motors with Controllers in a motor control center.
- C. Motors shall comply with the following requirements:
 - 1. Motors shall be built in accordance with the latest standards of NEMA and applicable IEEE standards and as specified. Motors shall be tested in accordance with ASA C50 and conform thereto with respect to insulation resistance and dielectric strength.
 - 2. Each motor shall be provided with conduit terminal box and adequate starting and protective equipment as specified or required. The capacity shall be sufficient to operate associated driven devices under all conditions of operation and load and without overload, and shall be at least the horsepower indicated or specified. Each motor shall be selected for quiet operation.
 - 3. Provide motors rated for 200 volts for 208 volt service. Provide 230 and 460 volt rated motors for 240 and 480 volt service. For hermetic refrigeration and elevator applications, motor voltage must match service voltage.

4. Brake horsepower load requirements at specified duty shall not exceed 85 percent of nameplate horsepower times NEMA service factor for motors with 1.0 and 1.15 service factors. For motors with 1.25, 1.35, and 1.4 service factors, maximum load percentage shall be 78 percent, 72 percent, and 70 percent, respectively. Brake horsepower load requirements do not apply for water-cooled or refrigerant-cooled motors.
5. Starting (locked rotor) currents shall not exceed NEMA Design B maximum values for the specified ratings.
6. Motors of open dripproof construction shall be NEMA Class B for operation for 40°C ambient. Except: Motors used in conjunction with variable frequency speed drive controller shall be inverter duty motors with NEMA Class F insulation based on Class B rise and meet NEMA MGI Part 31.
7. Where motors operate in an ambient temperature above 40°C, the motors shall be suitably designed for the ambient temperature indicated.
8. Outdoor, Exposed Motors: Totally enclosed fan-cooled construction, stator windings totally encapsulated having non-hygroscopic insulation approved for outdoor use and double shielded bearings.
9. Provide power factor correction as follows:
 - a. Individual single speed, non-reversing motors, 15 hp and larger, having a full load power factor of less than 90 percent, shall be supplied by the equipment supplier with power factor correcting capacitors which shall correct the full load power factor of the circuit to a minimum of 90 percent and the no load power factor to a maximum of unity. Where the power factor of the motor combined with a variable speed controller exceeds 90 percent at full load, power factor correction capacitors are not required.
 - b. These capacitors shall be sized by the motor manufacturer. The shop drawings for the equipment shall list the capacitor KVAR, and full load current of the motor-capacitor combination to enable proper sizing of the overload protection and the correct power factor at no load and full load.
 - c. Capacitors will: be 3-phase, rated for the applied circuit voltage, fused at 5 KVAR's and above; employ non-PCB impregnated paper or film dielectric and insulation; be in indoor dust-proof or NEMA Type 3R enclosure, depending on location; not contain more than 3 gallons of a combustible insulating liquid; be equipped with integral discharge resistors to reduce voltage to a maximum of 50 volts in three minutes.
 - d. Capacitors for individual motors shall be installed and connected under Division 16. Package or unitized equipment on which motors and controls are factory wired up to a point or points of power connection shall have the capacitors, as specified above, installed and connected to the motor circuits between the starters and the motors, as part of the factory supplied assembly.
 - e. Do not apply power factor correction to motors with variable frequency drives.
10. Single Phase Motors: Open type capacitor start with lifetime sealed ball bearing or oilable ball bearing type. Motors shall be NEMA premium efficiency motors.
11. Three Phase Motors: Polyphase induction type with lifetime ball bearing through 2 horsepower, anti-friction bearing with a minimum life of 250,000 hours under belt load conditions. Bearings shall be in regreasable race. Belt drive motors shall have steel adjustable slide base with slide rails and adjustment screws. Motors shall be NEMA premium efficiency motors.

12. Motors for use with Variable – Frequency Motor Controllers shall be designed for use with these Controllers and shall be tested with the specific Controller supplied for this project. Motors for use with Variable – Frequency Motor Controllers shall be provided with insulated bearings.

D. Manufacturers:

1. Lincoln
2. General Electric
3. Electric Machinery Company
4. Reliance

2.2 ENCLOSED CONTROLLERS (Starters, Combination Starter/Disconnects and Sentinel Switches)

- A. Furnish Enclosed Controllers for equipment and apparatus specified in this Division, as indicated on the contract documents, and as specified herein.
- B. Enclosed Controllers shall be furnished with appropriate fuses designed specifically for motor protection. [Fuses shall comply with requirements of Division 26 Section 262813.]
- C. Furnish Combination Starter/Disconnect type Enclosed Controllers for integral horsepower motors where remote control is specified or indicated.
- D. Furnish Starter type Enclosed Controllers for integral horsepower motors where no remote control is required, and manual operation is specified or indicated.
- E. Furnish Sentinel Switches for fractional horsepower motors where no remote control is required. (Toggle switches may be used for controlling single phase motors of 1/8 horsepower or less rating equipped with integral thermal protection.)
- F. Manufacturers:
 1. Furnish Enclosed Controllers as specified in Division 26 Section 262913, Enclosed Controllers.

2.3 ENCLOSED SWITCHES (Disconnects)

- A. Furnish Enclosed Switches for equipment and apparatus specified in this Division, as indicated on the contract documents, and as specified herein.
- B. Enclosed Switches shall be furnished with appropriate fuses designed specifically for motor protection. Fuses shall comply with the requirements of Division 26.
- C. Manufacturers:
 1. Furnish Enclosed Switches as specified in Division 26 Section 262816, Enclosed Controllers.

2.4 ADJUSTABLE-FREQUENCY MOTOR CONTROLLERS

- A. Furnish Variable – Frequency Motor Controllers for motors and equipment specified in this Division, as indicated on the contract documents, and as specified herein.

1. Provide the Variable – Frequency Motor Controller Manufacturer with a complete set of approved shop drawings for each pump and fan that will be driven by the Controller. Shop drawings will include pump and fan curves with operating points designated and will also include the motor shop drawings. (V belt drive losses will be assumed to be in accordance with AMCA Standards for fans.)
2. Provide all delivery and assembly work using appropriate tradesmen as required. In addition, if the Variable – Frequency Motor Controllers require any assembly or are delivered in more than one piece per Controller, all assembly and wiring inside the cabinets shall be provided. This wiring shall not include wiring to external control devices.
3. Provide level housekeeping pads in accordance with the Variable – Frequency Motor Controller Manufacturer's shop drawings.
4. Provide all interconnecting control wiring between the Variable – Frequency Motor Controllers and the building control system.
 - a. Note all control wiring shall be tagged near terminal strip connections and checked by the Variable – Frequency Motor Controller Manufacturer to verify proper connection to individual terminal strips.
5. Provide the Electrical Contractor with shop drawings of the Variable – Frequency Motor Controllers for installation.
6. Provide the Variable – Frequency Motor Controller Manufacturer with electrical single line drawings of the facility power distribution and other electrical data required for the AFD manufacturer's harmonic analysis.

B. Manufacturers:

1. Furnish Variable – Frequency Motor Controllers as specified in Division 26 Section 262923, Enclosed Controllers.

PART 3 – EXECUTION

3.1 HANDLING

- A. Electrical equipment furnished by this Contractor, but installed by the Electrical Contractor shall be delivered to the project site by this Contractor. The Electrical Contractor shall receive it at the project site, move it to its intended location and install it.

3.2 VARIABLE - FREQUENCY MOTOR CONTROLLERS START-UP

- A. The Variable – Frequency Motor Controller Manufacturer shall provide start-up service for each Controller on the project. In providing this service, it shall be expressly understood that the Manufacturer's representative shall be present during initial equipment startup and shall sign a startup data sheet or checklist for each Controller. Do not initially energize any Controller except in the presence of the Manufacturer's representative.
- B. The start-up service shall include the following
 1. Verify all control and power wiring connections.
 2. Check power lugs on source and load sides and tighten as required.
 3. Jog each motor to verify proper rotation.

4. Start and operate the Variable – Frequency Motor Controller including fan or pump.
 5. Operate each safety device. Repair each device as required.
 6. Physically check each motor and Variable – Frequency Motor Controller at start-up and shut down to insure no abnormal or problem conditions exist.
 7. Following successful start-up of the Variable – Frequency Motor Controllers, the manufacturer's representative shall provide a minimum of 16 hours instruction to the Owner's operators. Training will consist of one or two separate sessions, dates selected by the Owner.
- C. The start-up service by the Variable – Frequency Motor Controller Manufacturer shall also include a one-week period for simultaneously monitoring the incoming power and the load side power to problem drives with Dranetz meters
1. It shall be the Manufacturer's responsibility to prove that the problems exist outside of the Variable – Frequency Motor Controller itself, i.e., to prove the Controller itself is not at fault.
 2. Should this testing prove that the problems exist inside the Variable – Frequency Motor Controller, this service shall be performed at no additional cost to the Owner.
 3. Should this testing prove that the problems exist outside of the Variable – Frequency Motor Controller, i.e., problem is with electrical distribution system or with motor or with the fan/pump, the testing costs shall be borne by the responsible trades.

END OF SECTION 230513

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Digital Thermometers.
 - 2. Pressure gages.
 - 3. Pressure and temperature test plugs.

PART 2 - PRODUCTS

2.1 DIGITAL VARIABLE ANGLE SOLAR THERMOMETERS

- A. Thermometers shall be digital type within 1% accuracy. Unit shall be solar powered. Digital Thermometers shall be adjustable angle type, with 6 inch stem and 2-1/2 inch brass extension neck separable socket. .
- B. Manufacturers:
 - 1. Weiss
 - 2. Weksler

2.2 PRESSURE GAGES

- A. Provide pressure gauges at suction and discharge connections to pumps and as indicated on the drawings.
- B. Pressure gauges shall have 4-1/2 inch diameter stainless steel cases, no back flange, and removable stainless slip ring. Gauge dial shall be white coated with black figures, gradations, and micro adjustable. Gauges shall be capable of reading to approximately twice the working pressure. Accuracy: 1 percent.
- C. Provide pressure gauges with the following accessories:
 - 1. Valves: 1/4" brass or stainless-steel needle type.
 - 2. Syphons: 1/4" coil of brass tubing with threaded ends.
 - 3. Snubbers: ASME B40.5, 1/4" brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.
- D. Manufacturers:
 - 1. Weiss 4CTS-1
 - 2. Trerice 500XB
 - 3. Weksler EA14

2.3 PRESSURE AND TEMPERATURE TEST PLUGS

- A. Provide pressure and temperature test plugs as shown on the drawings and specified herein.
- B. Test plugs shall be a 1/4 inch MPT fitting to receive either a temperature or pressure probe with a 1/8 inch OD. Fitting shall be solid brass with two valve cores of Nordel (maximum 275°F), fitted with a color coded and marked cap with gasket and shall be rated at 1,000 psig. Fittings shall be Peterson Equipment Company, Incorporated, Pete's Plug, or approved equal.
- C. Manufacturers:
 - 1. Flow Design, Inc.
 - 2. Peterson Equipment Co., Inc.
 - 3. Trerice, H.O. Co.
- D. Provide two test kits with pressure gauge and thermometer. Pressure gauges shall have 0-50 psi dial range, and shall have adaptor with 1/8 inch probe of 304 stainless steel and union nut for use with pressure and temperature test plug. Thermometers shall have 0° to 220°F range. Test kits shall be Peterson Equipment Company, Incorporated, Series 1500 Test Kit, or approved equal.

PART 3 - EXECUTION

3.1 DIGITAL THERMOMETERS

- A. Install thermometers in oversize pipe tee and nipple.
- B. Thermometers shall be installed such that they are easily read from a normal observation point.

3.2 PRESSURE GAUGES

- A. Gauges shall be installed such that they are easily read from the normal observation point.
- B. Install needle-valve and snubber fitting in piping for each pressure gauge for fluids (except steam).
- C. Install needle-valve and syphon fitting in piping for each pressure gauge for steam.

3.3 PRESSURE AND TEMPERATURE TEST PLUGS

- A. Provide pressure and temperature test plugs where indicated on the drawings and one pair at every main to riser connection point. For this project, provide a minimum of two pair of pressure and temperature test plugs and main to riser connection points.
- B. Regardless if shown on the drawings or not, provide pressure and temperature test plugs on the inlet and outlet piping for each piece of equipment (including coils).

3.4 ADJUSTING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Ball valves.
2. High-performance butterfly valves.
3. Check valves.
4. Calibrated balance valves.
5. Automatic flow control valves.
6. Chainwheels.

- B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball and plug valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Valve Pressure and Temperature Ratings: Refer to Section 232113 "HVAC Piping" for component and equipment ratings. Components, fittings, equipment, coils, specialties, etc., shall meet the component's pressure rating listed, and as required for system pressures and temperatures.
- B. Valve Sizes: Same as upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every five plug valves, for each size square plug-valve head.
 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 2. Butterfly Valves: With extended neck.

E. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

F. Valve Bypass and Drain Connections: MSS SP-45.

G. Install valves in accessible locations.

H. Valves for equipment shutoff shall be size of pipe indicated on the drawings before reducing to equipment inlet/outlet size.

I. Valves above 7 feet in mechanical equipment rooms shall have chain-wheel operators.

2.2 BUTTERFLY VALVES

A. All Butterfly valves shall be high performance type.

B. Butterfly valves greater than 2 inches: ANSI full lug type with carbon steel body, 316 stainless steel disc, and gear operated hand wheel. Liner shall be 317 stainless steel with PTFE woven fabric. Class 150 body, 285 psi bubble tight shut-off in either direction.

2.3 BALL VALVES (HEATING WATER, AND CHILLED WATER)

A. Ball valves 3 inches and below: 600 WOG, chromium plated brass ball and stem, TFE seats, blow-out proof stem, and threaded or solder connections. Shall be full port type valve.

2.4 CHECK VALVES

A. Check valves shall be bronze body "Y" pattern swing check valves. Check valves shall have renewable bronze discs. Class 200 valves.

2.5 AUTOMATIC FLOW CONTROL VALVES

A. Automatic flow control valves shall automatically control flow to +5 percent accuracy. Ends as required. Test plugs for temperature and pressure readout. Pressure drop for automatic control valve shall be 2 psig at scheduled flow rate unless higher pressure differential is required. Ball valves on combination units shall have chrome plated ball, teflon packing, brass packing nut, and blowout proof stem.

2.6 CALIBRATED BALANCING VALVES

A. Calibrated balancing valves shall be bronze body/brass ball under 4 inches and cast iron body/brass vane 4 inches and above. Valves shall have differential pressure readout ports with check valve, 1/4 inch tapped drain/purge port, memory stop, calibrated nameplate.

2.7 APPROVED MANUFACTURERS

A. Butterfly Valves:

1. DeZurick HP Class 150, Bray Series 40, Jamesbury

B. Ball Valves

1. Heating Water, and Chilled Water: Apollo 70-200, Watts 6081, Stockham S-214-FBR, Jamesbury Series 400.

C. Check Valves: Stockham B-345, Milwaukee 507.

D. Automatic Flow Control Valves: Griswold, Flow Design.

E. Calibrated Balancing Valves: Bell & Gossett Circuit Setter Plus, DeZurick, and Rockwell

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide shut-off valves at inlet and outlet of each item of HVAC equipment, including but not limited to pumps, coils, fin-tube convectors, cabinet heaters, unit heaters, heat exchangers, and other similar equipment.
- B. Install valves so that the tops of the valve stems are above the horizontal.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Pipe hangers and supports.
 - 2. Equipment supports.

1.3 SEISMIC REQUIREMENTS

- A. Provide seismic-restraint hangers and supports for piping and equipment where applicable.

1.4 SUBMITTALS

- A. Provide product data for the following:
 - 1. Pipe hangers and supports.
- B. Provide fabrication and installation drawings and include load analyses calculations Signed and sealed by a registered professional engineer for the following:
 - 1. Pipe hangers and supports for piping 8 inches and larger
 - 2. Equipment supports.
- C. Welding certificates.

PART 2 - PRODUCTS

2.1 PIPE HANGER AND SUPPORT MANUFACTURERS

- A. Provide supports and hangers for the items included in the work. Hanger design and spacing shall conform to ANSI Code B 31.1.0 for Pressure Piping and the Manufacturers' Standardization Society of the Valve and Fitting Industry (MSS) SP-58 and SP-69, unless supplemented or modified herein.
- B. Manufacturers:
 - 1. Anvil.
 - 2. Approved Equivalent.

2.2 PIPE HANGERS AND SUPPORTS - GENERAL

- A. Submit for approval product bulletins with figure numbers of supports, hangers and inserts proposed for the various conditions and services.

- B. Supports shall secure pipes in place, prevent swaying and vibration, maintain required pitch by proper adjustment, and provide free expansion and contraction. Design supports to suit the loading and service, and not over stress the building structure.
- C. Hanger rods shall be threaded 1-1/2 inch on each end or all-threaded cadmium plated or galvanized steel. Hangers, rollers, and supports that are not plated shall be factory painted with a red oxide primer and black enamel finish.
- D. Specified bracket clamp and rod sizes are minimum size. Support and hanger design shall include a safety factor of 5.
- E. Where several pipes 4 inches in diameter and smaller can be installed in parallel at the same level, approved type trapeze hangers may be used in lieu of separate clevis hangers, with suspension rods having double nuts and securely attached to the building structure in an approved manner. Brace trapeze hangers to prevent motion due to expansion and contraction of pipe. Support individual pipes on trapeze by saddles and rollers. For trapeze hanger spacing, use the maximum support spacing listed for the smallest pipe on the trapeze.
- F. Plastic coated hangers and clamps shall be provided for uninsulated brass or copper pipes, unless shields are provided between hangers or clamps and uninsulated brass or copper pipes.
- G. Provide supplemental steel required for support of pipes other than steel shown on the structural drawings.
- H. Do not hang one pipe from another pipe, conduit, or ductwork.
- I. Do not use perforated band iron, wire, or chains as pipe hangers.
- J. Support piping as close as practical to heavy load concentrations such as vertical runs, branch connections, valves, and other pipe accessories such as air separators and strainers.
- K. Locate supports adjacent to both sides of control valves or pipe sections shown to be removable.
- L. Locate supports adjacent to branch shutoff valves to permit removal of branch piping without the installation of temporary supports.
- M. Support piping on at least one side and adjacent to each change in direction.
- N. Provide additional supports as specified elsewhere when grooved pipe construction is employed.
- O. Hangers for insulated pipes shall be sized to clear the outside diameter of the insulation, unless otherwise noted.
- P. Supports and hangers for horizontal piping shall be provided with a means of vertical adjustment after erection. Turnbuckles shall be provided with one lock nut. Rod connections to hangers and attachment devices shall be provided with two (2) nuts.
- Q. Inserts for pipe hangers shall be of a type that does not interfere with structural reinforcing and does not displace excessive amounts of concrete.
- R. Piping located near floors which can be supported from floor or walls shall be provided with approved floor stands, wall brackets, roller supports, masonry piers or similar items.

- S. Resilient hangers and isolation devices shall be provided on piping connected to rotating equipment including pumps and air handling units and on other piping which may vibrate and create audible noise. Refer to this division specification, Vibration and Seismic Controls, for additional requirements concerning vibration isolation at pipe supports..
- T. Additional hangers or supports shall be provided, as required, to stabilize and re-support any existing piping that is to remain and be reused in areas affected by demolition.
- U. Vertical piping shall utilize riser clamps specifically designed for piping.
- V. Pipe Hanger Schedule

Hanger Type	Manufacturers' Model Numbers			
	F&S	F&M	Grinnell	Central Iron
360 shield, split	981	---	---	548
Beam Clamp	55	282	218	39
Multi-J hook blade	120	---	---	208
Clevis hanger	86	239	260	10
180 degree shield	980	80	167	550
Rigid trapeze	710	---	Std. 46	551
U-bolt	37	176	137, 137C	98H
Adj. steel pipe stanchion	421	291	259	71
Welded steel bracket	800, 801	151, 155	195, 199	195, 199
Riser clamp	91, 93, 94	241	261, 261C	37, 261
Pipe rest	92, 925	---	---	552
Base elbow support	720, 721	---	---	67, 68
Double bolt pipe clamp	89	261	295	
Welded beam attachment	966	---	66	
Insert	180A, 180B	178	280 Series	100, 101
Cont. slotted insert	150A, 150B	190	---	50
Underground pipe hanger	275	---	---	600A

2.3 PIPE HANGERS AND SUPPORTS – PIPING 4 INCHES AND SMALLER

- A. Piping 4 inches and smaller shall be supported by hangers and supports referred to in MSS-SP69.
- B. Instrument air piping shall be supported with copper-plated Type 1 clevis hangers or Type 8 riser clamps.
- C. Cold water piping shall be supported with Type 40 protection shields and Type 1 clevis hangers.
- D. All other piping shall be supported by Type 1 adjustable steel clevis hangers.

- E. Hangers for piping with insulation shall be equipped with insulation inserts and protection shields. Support piping in accordance with the insert manufacturer's recommendations.
- F. Hangers for piping 4 inches and smaller with insulation shall be equipped with Type 40 protection shields. Hot service piping shall be equipped with calcium silicate insulation inserts.
- G. Support plastic piping in accordance with the piping system manufacturer's recommendations for the intended service based on the expected fluid temperatures.
- H. Copper piping shall be supported by copper or plastic clad hangers or shall be protected by plastic non-conducting spacers to prevent dielectric corrosion.
- I. Vertical piping shall be supported at floor levels with Type 8 riser clamps. Piping 2-1/2 inches and larger shall be provided with a minimum of two (2) shear lugs installed in accordance with PFI Standard ES-26. Support locations shall be selected to permit uniform loading, provision for expansion, or to suit space limitations. The riser clamps at exposed locations shall be of such design as to avoid creating a hazardous or unsightly condition and staying within the space limitations.
- J. Pipe guides shall be provided whenever piping has insufficient physical strength to maintain alignment with the force of lineal expansion applied.
- K. The base of piping at circulating pumps shall be Type 52 variable spring base supports or with stanchions. Pipe stanchions shall be a minimum of 1/3 to 1/2 the nominal pipe diameter of the pipe being supported and 1 inch minimum. The base plate shall be a minimum 1/4 inch thick and its size shall be selected for fastening to the floor with a minimum of two (2) 3/8 inch bolts.
- L. Piping 4 inches and smaller supported from the steel structure shall be supported by Type 23 beam clamps or by inserts and/or expansion bolts in the floor structure above.
- M. Piping along walls shall be supported by Type 33 brackets with drilled horizontal legs for fastening standard hangers and hanger rods, and vertical legs shall be fastened to the wall with at least two (2) fasteners.
- N. Where several pipes can be installed in parallel at the same level, provide trapeze hangers constructed of uni-strut or steel angle suspended by hanger rods. Brace trapeze hangers to prevent motion due to expansion and contraction of the pipe. Support individual pipes by hangers or rollers.
- O. Support spacing for horizontal steel piping. The support spacing listed below is the maximum normal spacing, and does not reduce the need for additional hangers and supports when specified elsewhere.

Steel Pipe Size	Minimum Rod Size	Maximum Support Spacing
1-1/4 inches and smaller	3/8 inch diameter	7' - 0"
1-1/2 inches	3/8 inch diameter	9' - 0"
2 inches	3/8 inch diameter	10' - 0"
2-1/2 inches	1/2 inch diameter	11' - 0"
3 inches	1/2 inch diameter	12' - 0"
4 inches	5/8 inch diameter	14' - 0"
5 inches	5/8 inch diameter	15' - 0"

Steel Pipe Size	Minimum Rod Size	Maximum Support Spacing
6 inches	3/4 inch diameter	17' – 0"

- P. Support spacing for horizontal copper piping. The support spacing listed below is the maximum normal spacing, and does not reduce the need for additional hangers and supports when specified elsewhere.

Copper Pipe Size	Minimum Rod Size	Maximum Support Spacing
3/4 inch and smaller	3/8 inch diameter	5' – 0"
1 inch	3/8 inch diameter	6' – 0"
1-1/4 inches	3/8 inch diameter	7' – 0"
1-1/2 inches	3/8 inch diameter	8' – 0"
2 inches	3/8 inch diameter	8' – 0"
2-1/2 inches	1/2 inch diameter	9' – 0"
3 inches	1/2 inch diameter	10' – 0"
4 inches	1/2 inch diameter	12' – 0"

2.4 PIPE HANGERS AND SUPPORTS – PIPING 6 INCHES AND LARGER

- A. Piping 6 inches and larger: Piping supports and hangers for piping is to be designed by a Professional Engineer who is registered in the State of Maryland.
- B. Pipe expansion, hangers, guides, and anchors shown on the Drawings are partially complete and are shown to establish the basic hanger criteria for type, size and layout. The Contractor shall provide additional expansion, hangers, supports, anchors and guides required to complete the work at no additional cost to the Owner.
1. Piping 6 inches and larger shall not be connected to floor slabs or bar joints. These pipes shall be supported directly from the building's steel structure or from miscellaneous structural steel provided by the Contractor.
- C. Provide the services of a Professional Engineer who is registered in the State of Maryland to perform dead load analyses and pipe stress analyses on piping systems where the piping is 6 inches or larger in diameter.
- D. Once final pipe layouts have been established and coordinated with the other disciplines, a set of these drawings shall be forwarded to the Professional Engineer who shall in turn complete his pipe dead load and stress analysis, and shall select and design the pipe hangers, supports and guides. Shop drawings shall then be prepared. Shop drawings shall be stamped by the Professional Engineer with his/her registration seal prior to submission for approval.
- E. When required, pipe supports located in Mechanical Equipment Rooms shall be provided with spring vibration isolation hangers. Additionally, vibration isolation type supports and hangers shall be provided in all vertical mechanical shafts. Refer to this division specification, Vibration and Seismic Controls, for additional requirements.
- F. Hot water supply and return piping with horizontal movements exceeding 1/2 inch shall be supported with Type 39 protection saddles or with Type 40 protection shields on Type 46

adjustable pipe roller and base supports or Types 41 or 43 roller hangers. Where horizontal movements are less than 1/2 inch use Type 1 clevis hangers or Type 3 pipe clamps.

- G. Chilled water piping shall be supported with Type 40 protection shields and Type 41, 43 or 44 roller hangers where horizontal movements exceed 1/2 inch. Where horizontal movements are less than 1/2 inch, use oak blocking with oversized Type 1 clevis hangers. Insulation inserts or oak blocking shall be of square dimension equal to the insulation thickness specified and 12 inches long. In addition, Type 40 protection saddles shall be provided.
- H. Pipe guides shall be provided whenever piping has insufficient physical strength to maintain alignment with the force of lineal expansion applied.
- I. Piping supported from the steel structure shall be supported by suitable type beam welding attachments.
- J. The base of piping at circulating pumps shall be supported by pipe stanchions. Pipe stanchions shall be a minimum of 30 percent of the nominal pipe size of the pipe being supported. The base plate shall be a minimum 1/2 inch thick and its size shall be selected for fastening to the floor with a minimum of four (4) 1/2 inch bolts.
- K. Piping connections to pressure vessels, such as chillers, boilers, and heat exchangers, shall be supported from overhead in such a manner that no pipe load is exerted on the vessel nozzles.
- L. Vertical piping 8 inches and larger shall be supported at its lowest level by pipe stanchions. Pipe stanchions shall be a minimum of 30 percent of the nominal pipe size of the pipe being supported. It shall be provided with a base plate limiting loading on the structure to 2,000 pounds per square foot. The riser shall be supported on higher levels by riser clamps. Clamps shall be restricted from movement along the pipe by welding a minimum of four (4) shear lugs to the pipe. Refer to PFI Standard ES-26 for the shear lug requirements. Support locations shall be selected to permit uniform loading, provision for expansion or to suit space limitations. The riser clamps at exposed locations shall be of such design as to avoid creating a hazardous or unsightly condition and staying within space limitations.
- M. Support spacing for horizontal steel piping. Support spacing listed below is the maximum normal spacing, and does not reduce the need for additional hangers and supports when specified elsewhere.

Steel Pipe Size	Minimum Rod Size	Maximum Support Spacing
8 inches	7/8 inch diameter	19' – 0"
10 inches	7/8 inch diameter	22' – 0"
12 inches	7/8 inch diameter	23' – 0"
14 inches	1 inch diameter	25' – 0"
16 inches	1 inch diameter	27' – 0"
18 inches	1 inch diameter	24' – 0" (see Note below)
20 inches	1-1/4 inch diameter	22' – 0" (see Note below)
24 inches	1-1/4 inch diameter	18' – 0" (see Note below)
30 inches	1-1/2 inch diameter	15' – 0" (see Note below)

NOTE: For pipe sizes 18 through 30 inches, the support load requirements exceed the capacity requirements of standard manufactured supports. Therefore, use of larger support spacing is permitted only when custom designed supports are provided.

2.5 EQUIPMENT SUPPORTS

- A. Provide welded, shop-fabricated or field-fabricated equipment supports made from structural-steel shapes as required by the contract documents.
- B. Equipment supports shall be capable of supporting the combined operating weight of supported equipment and the connected systems and components.
- C. Provide the services of a Professional Engineer who is registered in the State of Maryland to perform analyses for equipment supports provided.

PART 3 - EXECUTION

3.1 HANGERS AND SUPPORT SCHEDULE

Building Construction	Pipe Support Method
Poured concrete floor slabs	Galvanized steel inserts, and/or fishplates of sufficient area to support twice the calculated dead load.
Building structural steel	Beam attachments and similar devices.
Precast concrete floor slabs	Fishplates of sufficient area to support twice the calculated dead load and approve type specialty hanger accessories manufactured for the specific purpose of attaching to precast floors.
Metal deck floor slabs with concrete fill	Galvanized steel inserts and/or fishplates of sufficient area to support twice the calculated dead load, and approved type specialty hanger accessories manufactured for the specific purpose of attaching to metal deck floors.
Concrete slabs where piping revisions are required and approved after slabs are poured or existing concrete slabs	"Phillips" or "Hilti" expansion bolts and shields for piping 4" and smaller, with main supports welded to structural steel at maximum 20 feet on center 4" x 4" x 3/8" thick clip knee angles with 3/4" expansion bolt in shear (horizontal) and supporting rod at 90° from anchor bolt for piping greater than 4", attached to concrete beams or columns.
Concrete floor slabs on grade with ground water condition	Drainage, waste and vent piping to be encased in slab construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Provide hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- B. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, loops, and bends.

- C. Provide lateral bracing with pipe hangers and supports to prevent swaying.
- D. Provide building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- E. Install hangers and supports so piping loads and stresses from movement will not be transmitted to connected equipment.
- F. Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- G. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

END OF SECTION 230529

SECTION 230533 – ELECTRIC HEAT TRACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Self-regulating electric heat tracing.
- B. Controls.
- C. Accessories.

1.3 SUBMITTALS

- A. Provide the following with shop drawing submission:
 - 1. Tabulation of each heat trace circuit including I.D. number, pipe name, pipe size, pipe length, heat trace size, heat trace length, normal circuit current draw (amps), and inrush circuit current draw (amps at 0°F).
 - 2. Electrical schematic of total heat trace system including each heat trace circuit. Include ambient thermostat, pipe line thermostats and circuit draw from previous tabulation; recommend circuit size.
 - 3. Isometric schematic of piping identifying each circuit location and each thermostat location.
 - 4. Product data (include derating for 208 volt and 277 volt).
 - 5. Installation data

PART 2 - PRODUCTS

2.1 ELECTRIC HEAT TRACING

- A. Electric heat tracing shall be of the self-regulating type in which the power output is regulated in response to the pipe temperature. Heat trace conductor shall:
 - 1. Decrease output as the system reaches thermal stability.
 - 2. Be capable of being cut to desired lengths in the field.
 - 3. Be capable of overlap without burnouts.
 - 4. Be capable of splicing anywhere along its length.
- B. Heat tracing shall operate on available electrical power. Unless shown otherwise on the drawings, heat tracing shall be 120 volt
- C. Heat tracing for hot water, steam, and steam condensate piping shall be rated for 250°F maximum continuous exposure temperature in a non-hazardous environment. Tracing shall consist of a flat, flexible, low heat density electric heater strip of parallel circuit construction, consisting of two 14 AWG bussbars separated by a fluoropolymer spacer and helically wrapped with a self-regulating fluoropolymer fiber that controls power output. This core shall be insulated

with a fluoropolymer inner jacket plus provided with a tinned copper braid and an outer jacket of fluoropolymer covering the braid.

1. Manufacturers: (pipe sizes 6 inches and smaller)
 - a. Raychem 5XTV
 - b. Nelson HLT5-J
 - c. Delta-Therm HT5-F
 2. Manufacturers: (pipe sizes 8 inches and larger)
 - a. Raychem 10XTV
 - b. Nelson HLT10-J
 - c. Delta-Therm HT10-F
- D. Heat tracing for chilled water and condenser water piping shall be rated for 150°F maximum continuous exposure temperature in a non-hazardous environment. Tracing shall consist of a flat, flexible, low heat density electric heater strip of parallel circuit construction, consisting of two 16 AWG bussbars and a continuous inner core of self-regulating conductive polymer material. This core shall be insulated with a polyolefin jacket plus provided with a tinned copper braid and an outer jacket of either fluoropolymer or polyolefin covering the braid as appropriate for the application.
1. Manufacturers: (pipe sizes 6 inches and smaller)
 - a. Raychem 5XL
 - b. Nelson LT5-J
 - c. Delta-Therm IN5-F
 2. Manufacturers: (pipe sizes 8 inches and larger)
 - a. Raychem 8XL
 - b. Nelson LT8-J
 - c. Delta-Therm IN8-F
- E. Heat tracing on flat surfaces shall be rated for 150°F maximum continuous exposure temperature in a non-hazardous environment. Tracing shall consist of a flat, flexible, low heat density electric heater strip of parallel circuit construction, consisting of two 16 AWG bussbars and a continuous inner core of self-regulating conductive polymer material. This core shall be insulated with a polyolefin jacket plus provided with a tinned copper braid and an outer jacket of either fluoropolymer or polyolefin covering the braid as appropriate for the application.
1. Manufacturers:
 - a. Raychem 8XL
 - b. Nelson LT8-J
 - c. Delta-Therm IN8-F.
- F. All valves and fittings shall be insulated with equivalent pipe lengths of heater strip in accordance with manufacturer's recommendations.

2.2 CONTROLS

- A.. Provide the manufacturer's standard control and monitoring package with LED panel display indicating program mode, actual temperature, control temperature, heater current, power on, heater on, alarm conditions, programming parameters, and ground fault/overcurrent protection. Provide appropriate contacts for monitoring of circuits alarm and status conditions by the building automation system. Monitor power availability on load side of circuit protection.
1. Provide control panel enclosure as follows:
 - a. NEMA 12 for indoor applications.
 - b. NEMA 4 for outdoor applications.
 2. Manufacturers:
 - a. Raychem HTPG
 - b. Nelson CM-1
 - c. Delta-Therm GFPE
- B. Each length of heat trace on piping with normally active flow shall be controlled by a strap-on pipe thermostat to prevent operation above 40°F. An outdoor ambient thermostat shall be provided to de-energize the entire circuit at outdoor temperatures above 50°F.
- C. Each length of continuous pipe with possibly inactive flow (condenser water return riser and condenser water supply riser from sump) shall be provided with heat trace having its own strap-on pipe thermostat and junction box to prevent operation above 40°F.
- D. Each length of continuous pipe with normally inactive flow (drain lines and dead end mains) shall be provided with heat trace and shall be automatically energized when outdoor ambient drops below 50°F without use of a strap-on pipe thermostat.
- E. Each length of continuous pipe shall have its own junction box. All wiring between junction boxes shall be provided and shall be run in weatherproof conduit. A single source of power shall be provided by the Electrical Contractor to the heat trace control panel. The HVAC Contractor shall be responsible for the circuitry from the monitoring panel. All work will be performed by a registered electrical contractor according to Division 26 Specifications. Individual piping circuits shall be wired separately from this source. Provide NEMA 3R disconnect switches to isolate individual heat trace circuits.

2.3 ACCESSORIES

- A. Provide heat tracing installation accessories as required for a complete and functional system including, but not limited to:
1. Glass cloth, adhesive fiberglass tape, heat-conductive putty, clips and cable ties
 2. Splices, silicone end seals, and tee kits.
 3. Power connection kit.
 4. Ground fault protection devices.
- B. Provide warning tape on piping with heat tracing. Warning tape to be continuously printed "Electrical Tracing"; and be constructed of 3 mil vinyl with pressure-sensitive, permanent, waterproof, self-adhesive back.

1. Width for Markers on pipes 6 inches and smaller (including insulation): 3/4 inch min.
2. Width for Markers on pipes 8 inches and larger (including insulation): 1-1/2 inches min.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install electric heating cable according to manufacturer's recommendations
- B. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- C. Install electric heating cables after piping has been tested and before insulation is installed.
- D. Install electric heating cables according to IEEE 515.1.
- E. Install insulation over piping with electric cables according to Division 23 Section "HVAC Insulation."
- F. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- G. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Protect installed heating cables and leads, from damage.

END OF SECTION 230533

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Restrained vibration isolation roof-curb rails.
 - 12. Seismic snubbers.
 - 13. Restraining braces and cables.
 - 14. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: 90 MPH.
 - 2. Building Classification Category: II.
 - 3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: C.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
 - a. Refer to the structural drawings for the Seismic analysis including the Component Factor, Component Modification Factor, and the Amplification Factor.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 12.7 percent.
4. Design Spectral Response Acceleration at 1-Second Period: 6.0 percent.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases where required.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other sections for equipment mounted outdoors.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic- and Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods,

- and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
- c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For professional engineer and testing agency.
- F. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices where required shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Mechanical equipment, piping and ductwork shall be provided with, and mounted on, vibration isolators.
- B. The work specified herein shall include providing all labor, tools, equipment, materials, etc., necessary for a complete operational vibration isolation system.
- C. Isolators shall be selected to provide stable starting and stopping, and equipment shall not have excessive movement.
- D. When required to prevent excessive lateral motion due to fan starting, provide a lateral-type thrust restraint isolator. Lateral thrust restraint isolator shall not interfere with horizontal isolation.
- E. Select isolators for not less than the deflections indicated on the schedule. Isolators shall be properly selected for the weights of the mechanical equipment provided.
- F. Isolators located outdoors shall be hot dipped galvanized.
- G. Isolators for mechanical equipment shall be selected to provide conformance with the latest code with respect to seismic restraint.

2.2 VIBRATION ISOLATORS

- A. Springs
 - 1. Spring isolators shall be freestanding, unoused, laterally stable steel springs wound from a high-strength spring steel. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50 percent overload capacity.
 - 2. Springs shall be selected to provide minimum operating static deflections shown on the vibration isolation schedule below.
- B. Elastomer Element
 - 1. The elastomer insert shall be neoprene, molded from oil resistant compounds and shall be color coded to indicate load capacity and selected to operate within its published load range.
- C. Hanger Bracket
 - 1. The hanger bracket shall be welded steel and designed to carry a 500 percent overload without failure and to allow a support rod misalignment through a 30° arc without metal-to-metal contact or other short circuit.

2.3 BASES

A. Type 1 - Structural Rail Bases

1. Bases shall be structural beam sections, with welded-on isolator support brackets and prelocated and drilled anchor bolt holes or skids, and shall be designed and supplied by the isolation materials manufacturer.
2. Beam sections shall not be structurally connected to each other. Minimum section depth of each member shall be equivalent to 8 percent of the longest span between supporting isolators.
3. Isolator support brackets shall be welded to the structural beams as required to obtain the lowest mounting height for the supported equipment.
4. Product: Peabody Noise Control, Inc., Model SBB; Mason Industries, Model ICS; Amber Booth Custom Fabricated Structural Steel Rail Bases.

B. Type 2 - Integral Structural Rail Bases

1. Bases shall be fabricated from structural beam sections as described above, except that lateral cross members will be added to form a structurally integral, welded frame to provide a rigid, distortion-free common frame to support and anchor separate equipment components or driving and driven members.
2. Product: Peabody Noise Control, Inc., Model SFB; Mason Industries Model WF; Amber Booth Custom Fabricated Structural Steel Rail Bases.

C. Type 3 - Concrete Inertia Bases

1. Bases shall be constructed of concrete cast into a prefabricated inertia base frame assembly designed and supplied by the isolation materials manufacturer. Concrete shall be cast into base in the field.
2. Frame members shall be welded to form a structurally integral assembly, complete with primer-painted steel perimeter members, welded and tied reinforcing rods, recessed isolator brackets, and equipment anchoring bolts. Bases shall be shipped ready for pouring of concrete fill in the field.
3. Product: Peabody Noise Control, Inc., Model CIB; Mason Industries Model K; Amber Booth Custom Fabricated Structural Steel/Concrete Inertia Bases.

2.4 ROOF CURB

A. Type 4 - Roof Curb Rails

1. Rails to support rooftop equipment shall be designed to provide isolation against the transmission of vibrations to the building structure.
2. Rail assembly shall consist of extruded or roll-formed top and bottom members with spring isolators incorporated and with a continuous air and water seal provided for the entire rail perimeter. Spring isolators shall be selected and spaced according to weight distribution.
3. Spring components shall meet all the specified characteristics described under paragraph 2.1 A of this section.
4. Product: Peabody Noise Control, Inc., Model KSR; Mason Industries Model CMAB; Amber Booth Model RTIR.

2.5 ISOLATORS

A. Type A - Machinery Mounting Pads

1. Pad mounts shall be double ribbed elastomer multiple layer with metal shims between. Pads shall be 65 durometer and designed to permit 120 psi loading. Provide bearing plates to distribute loads.
2. Product: Peabody Noise Control, Inc., Model NGD; Mason Industries Model WSW; Amber Booth Model SP-NR Style E.

B. Type B - Restrained Spring Isolators

1. Vibration isolators for equipment which is subject to load variations and large external or torquing forces shall consist of large diameter laterally stable steel springs assembled into formed or welded steel housing assemblies designed to limit vertical movement of the supported equipment.
2. Housing assembly shall be formed or fabricated steel members and shall consist of a top-load plate complete with adjusting and leveling bolts, vertical restraints, isolation washers and a bottom plate with non-skid noise stop pads and holes provided for anchoring to supporting structure.
3. Spring elements shall meet all the specified characteristics described in paragraph 2.1 A of this section.
4. Product: Peabody Noise Control, Inc., Model FLS; Mason Industries Model SLR; Amber Booth Model CT.

C. Type C - Freestanding Isolators

1. Springs shall be assembled between a top and bottom steel load plate. The upper load plate shall be provided with a steel leveling bolt lock-nut and washer for attachment to the supported equipment. The lower load plate shall have a non-skid noise isolation pad bonded to the bottom and have provisions for bolting the isolator to the supporting structure.
2. Spring elements shall meet all the specified characteristics described in paragraph 2.1 A of this section.
3. Product: Peabody Noise Control, Inc., Model FDS; Mason Industries Model SLF; Amber Booth Model SW.

D. Type D - Neoprene Vibration Isolators

1. Vibration isolators shall be neoprene, molded from oil-resistant compounds, with cast-in-top steel load transfer plate for bolting to supported equipment and a bolt-down plate with holes provided for anchoring to supporting structure. Top and bottom surfaces shall have non-skid ribs.
2. Neoprene vibration isolators shall have minimum operating static deflections as shown on the vibration isolation schedule or as indicated on the project documents but not exceeding published load capabilities.
3. Except where support rails come integral with equipment, provide Type 1 or Type 2 rail bases to distribute the load.
4. Product: Peabody Noise Control, Inc., Model RD; Mason Industries Model ND; Amber Booth Model RV.

2.6 THRUST RESTRAINTS

- A. Thrust restraints will be provided where required to reduce movements associated with fan thrust.
- B. Spring elements shall meet all the specified characteristics described in paragraph 2.1 A of this section.
- C. Thrust restraints will be provided in sets of two (2).
- D. Product: Peabody Noise Control, Inc., Model HSR; Mason Industries Model WB; Amber Booth Custom Fabricated Thrust Restraints.

2.7 HANGERS

- A. Type E - Neoprene Hanger
 - 1. Vibration isolators with maximum static deflection requirements under the operating load conditions not exceeding .40 inches shall be hangers consisting of an elastomer-in-shear insert encased in a welded steel bracket and provided with a stamped load transfer cap.
 - 2. Elastomer insert shall meet all the specified characteristics described in paragraph 2.1 B of this section.
 - 3. Hanger bracket shall meet all the specified characteristics described in paragraph 2.1 C of this section.
 - 4. Product: Peabody Noise Control, Inc., Model RH; Mason Industries Model HD; Amber Booth Model BRD.
- B. Type F - Spring Hanger
 - 1. Vibration isolators for suspended equipment, with minimum static deflection requirement exceeding .4 inches, shall be hangers consisting of a freestanding, laterally stable steel spring and elastomeric washer in series, assembled in a stamped or welded steel bracket.
 - 2. Hanger bracket shall meet all the specified characteristics described in paragraph 2.1 C of this section.
 - 3. The spring element shall meet all the specified characteristics described in paragraph 2.1 A of this section.
 - 4. Product: Peabody Noise Control, Inc., Model SH; Mason Industries Model PCHS; Amber Booth Model BSW-2
- C. Type G - Combination Neoprene/Spring Hanger
 - 1. Vibration isolators for suspended equipment, where both high and low frequency vibrations are to be isolated, shall be hangers consisting of a laterally stable steel spring in series with an elastomer-in-shear insert, complete with load transfer plates and assembled in a welded steel bracket.
 - 2. The elastomer-in-shear element shall meet all the specified characteristics described in paragraph 2.1 B of this section.
 - 3. The spring element shall meet all the specified characteristics described in paragraph 2.1 A of this section.
 - 4. The welded hanger bracket shall meet all the specified characteristics described in paragraph 2.1 C of this section.

1. Product: Peabody Noise Control, Inc., Model SRH; Mason Industries Model PCDNHS; Amber Booth Model BSWR-2.

D. Additional Requirements for Spring Hangers

1. Springs on hangers for piping and ductwork shall be factory pre-compressed.

2.8 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:
1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 4. Hilti, Inc.
 5. Kinetics Noise Control.
 6. Loos & Co.; Cableware Division.
 7. Mason Industries.
 8. TOLCO Incorporated; a brand of NIBCO INC.
 9. Unistrut; Tyco International, Ltd.
- D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- E. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.
- F. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- G. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

- H. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- I. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- J. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- K. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- L. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- M. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.9 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

2.10 EQUIPMENT, PIPING AND DUCTWORK ISOLATION SCHEDULE

- A. Vibration isolation for equipment shall be provided in accordance with the schedule below except as otherwise noted:

	EQUIPMENT LOCATION										
	GRADE			20' SPAN				30' SPAN			
	ISOLA- TOR	DEFLE C- TION	BASE HANGER	ISOLA- TOR	DEFLE C- TION	BASE HANGE R	ISOLA-DEFLEC TOR	- TION	BAS E		
AIR COOLED CONDENSING UNITS ⁴											
Less than 301 RPM ⁵	D	0.25"	--	--	B	3.50"	--	--	B	3.50"	--

EQUIPMENT LOCATION

ISOLATED EQUIPMENT	GRADE		20' SPAN				30' SPAN				
	ISOLA- TOR	DEFLE C- TION	BASE HANGER		ISOLA- TOR	DEFLE C- TION	BASE HANGE R		ISOLA-DEFLEC TOR	- TION	BAS E
301 To 500 RPM	D	0.25"	--	--	B	2.50"	--	--	B	2.50"	--
Above 500 RPM	D	0.25"	--	--	B	1.50"	--	--	B	1.50"	--

AIR HANDLING UNITS, CABINET FANS, AIR CONDITIONING UNITS
 Internal spring isolation on individual fans

AXIAL AND TUBULAR CENTRIFUGAL FANS^{4,7}

22" and Below Wheel
 Diameter

D	0.25"	--	G	C	1.00"	--	G	C	1.00"	--
---	-------	----	---	---	-------	----	---	---	-------	----

24" and Above Wheel Diameter - 2" Static Pressure and Below

Less than 301 RPM ⁵	C	2.50"	2*	G	C	3.50"	3	G	C	3.50"	3
301 to 500 RPM	C	1.00"	2*	G	C	1.75"	2*	G	C	2.50"	3
Above 500 RPM	C	1.00"	2*	G	C	1.75"	2*	G	C	1.75"	2*

24" and Above Wheel Diameter - Over 2" Static Pressure

Less than 301 RPM ⁵	C	2.50"	3	G	C	3.50"	3	G	C	3.50"	3
301 to 500 RPM	C	1.75"	3	G	C	1.75"	3	G	C	2.50"	3
Above 500 RPM	C	1.00"	3	G	C	1.75"	3	G	C	1.75"	3

CENTRIFUGAL FANS AND UTILITY SETS⁷

22" and Below Wheel Diameter

50 HP and Below	D	0.25"	2*	G	C	1.00"	2*	G	C	1.00"	2*
Above 50 HP	C	1.75"	3	G	C	1.75"	3	G	C	1.75"	3

24" and Above - 50 HP and Below

Less than 301 RPM ⁵	C	2.50"	2*	G	C	3.50"	2*	G	C	3.50"	2*
301 to 500 RPM	C	1.75"	2*	G	C	1.75"	2*	G	C	2.50"	2*
Above 500 RPM	C	1.00"	2*	G	C	1.00"	2*	G	C	1.00"	2*

24" and Above - Above 50 HP

Less than 301 RPM ⁵	C	2.50"	3	G	C	3.50"	3	G	C	3.50"	3
301 to 500 RPM	C	1.75"	3	G	C	1.75"	3	G	C	2.50"	3

ISOLATED EQUIPMENT	EQUIPMENT LOCATION										
	GRADE			20' SPAN			30' SPAN				
	ISOLA- TOR	DEFLE C- TION	BASE HANGER	ISOLA- TOR	DEFLE C- TION	BASE HANGE R	ISOLA-DEFLEC TOR	- TION	BAS E		
Above 500 RPM	C	1.00"	3	G	C	1.75"	3	G	C	1.75"	3

* = Base 1 may be substituted for Base 2 provided isolated equipment is rigid and will resist torquing.

Notes:

- 1 Provide Type 1, 2 or 3 Base if required to stabilize supported equipment.
 - 2 Provide 12" thick Type 3 Base for pumps over 75 HP.
 - 3 Provide Type 3 Base large enough to provide elbow support for piping.
 - 4 Provide Type 1 or 2 Base if required to support equipment properly.
 - 5 Isolator natural frequency shall be 40 percent of the lowest equipment operating speed.
 - 6 Provide Type 3 Base weighing 10 times maximum equipment unbalanced forces.
 - 7 Provide thrust restraints for equipment scheduled to operate over 2" static pressure.
 - 8 Provide external vibration isolation on air handling units when factory supplied internal isolation is unavailable.
- B. Noise and vibration isolator types and minimum operating static deflections for suspended or floor-mounted piping shall be as follows:
1. Type E, Type F and Type G hangers, or Type A and Type C floor mounts, with minimum operating static deflections equivalent to 50 percent of connected equipment isolator deflection shall be used to support all piping over 1 inch outside diameter located within mechanical equipment rooms and for a minimum of 50 feet, whichever is greater, from connections to vibration isolated mechanical or electrical equipment. Above requirement shall include pressure reducing stations.
 2. For suspended piping, Type E or Type F, except first five hanger points connected to isolated equipment shall be Type G.
 3. For floor-mounted piping, Type C isolator for the first five support points, then Type A isolator.
 4. All piping connected to fire pumps and sprinkler systems do not require isolation. Do not isolate anchor points or bases for pipe risers.
- C. Noise and vibration isolator types and minimum operating static deflections for suspended or floor-mounted sheet metal ductwork, air plenums, pressure reducing valves, sound traps and similar air distribution elements shall be as follows:
1. Type G hangers, or Type C floor mounts with minimum operating static deflections equivalent to 50 percent of connected equipment isolator deflection, or 1 inch, whichever is greater, shall be used to support all sheet metal air distribution elements located within mechanical equipment rooms and for a minimum of 50 feet from connections to vibration isolation mechanical equipment.

- D. Isolator types are scheduled to establish minimum standards. Labor saving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages, provided isolators supplied incorporate the specified isolator type and do not degrade the noise and vibration isolation of equipment mounted.
- E. Specified supplemental equipment base types can be deleted for unitary packaged air handling equipment having a rigid frame and casing providing a distortion-free platform for attachment of vibration isolators.
- F. Provide flexible connections on all ductwork connected to isolated equipment. Neoprene rubber flexible connection and mounting flange shall have a pressure rating 20 percent greater than duct system pressure.
- G. Provide flexible connections on all piping connected to isolated equipment. Provide control rods with neoprene sleeves and neoprene washers to eliminate metal-to-metal contacts. Connector pressure rating shall be 20 percent greater than system pressure rating. On rotating equipment, provide flexible connections parallel to the rotating shaft.
 - 1. Product: Metraflex Metrasphere; Mason Industries Model MFNC; Keyflex Model 1512; Hyspan Series 5500.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 23 Section "HVAC Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
 - 11. Test and adjust air-mounting system controls and safeties.
 - 12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning and Information labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Valve tags.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Provide multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
 - 1. Labels shall have a white background with black lettering..
 - 2. Labels shall be able to withstand temperatures up to 160 deg F.
 - 3. Minimum Label Size shall not be less than 2-1/2 by 3/4 inches. Length and width can vary for required label content.
 - 4. Minimum Letter Size shall not be less than 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 5. Fasten labels to equipment with stainless-steel rivets or self tapping screws. Utilize contact-type permanent adhesive outdoors. No fluets in any situations
- B. Primary label content is to include equipment's Drawing designation or unique Owner's equipment number. Secondary label content is to include other information such as capacities, operating characteristics, or areas served.

2.2 WARNING AND INFORMATION LABELS

- A. Provide warnings and information labels where indicated on drawings or required by the specifications. Labels shall multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
 - 1. Warning Labels shall have a yellow background with black lettering.
 - 2. Information Labels shall have a white background with red lettering..
 - 3. Labels shall be able to withstand temperatures up to 160 deg F.
 - 4. Minimum Label Size shall not be less than 2-1/2 by 2-1/2 inches. Length and width can vary for required label content.

5. Minimum Letter Size shall not be less than 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasten labels where indicated with stainless-steel rivets or self tapping screws. Utilize contact-type permanent adhesive outdoors or for watertight applications.

B. Provide label content as indicated.

2.3 PIPE LABELS

A. Pipe Labels (Above Ground—Indoor)

1. Pipe bands indicating contents and flow direction shall be flexible vinyl film with acrylic pressure sensitive adhesive suitable for pipe surface temperatures of -40°F to 220°F.
2. Manufacturers:
 - a. Seton Opticode
 - b. W.H. Brady B-350 Perma-Code
 - c. Bunting Identiflow

B. Pipe Labels (Above Ground—Outdoor)

1. Pipe bands indicating contents and flow direction shall be snap-on markers consisting of a surface-printed and overcoat-protected vinyl base material suitable for pipe surface temperatures from -40°F to 150°F.
2. Manufacturers:
 - a. Seton Weather-Code, Style AA
 - b. W.H. Brady B-915 BradySnap-On
 - c. Bunting

C. Pipe marking shall comply with ANSI A13.1 Scheme for the Identification of Pipe Systems. Markers shall be in compliance with respect to:

1. Marker length
2. Background color
3. Letter color
4. Letter size

2.4 DUCT LABELS

A. Provide color-coded ductwork labels with factory lettering indicating fan system identification, service, and direction of flow. Duct labels for indoor ductwork shall be flexible vinyl film with acrylic pressure-sensitive adhesive suitable for duct surface temperatures of -40°F to 220°F.

2.5 VALVE TAGS

- A. Provide 0.032 inch thick Brass tags with stamped numbers and letters (black-filled), 1-1/2 inch square with 1/2 inch numbers and 1/4 inch letters.
- B. Fastening shall be by brass "S" hooks, brass jack chains, or brass ball chains.

- C. Provide project valve charts. Valve charts shall be 8-1/2 inch by 11 inch (minimum or of sufficient size), wood or aluminum framed with Plexiglas covers. Include valve numbers, sizes, functions, and locations. Coordinate location with Owner. Charts shall have key plan denoting approximate valve location.
 - 1. Include a copy of the project valve chart in the Operation and Maintenance Manuals.

PART 3 - EXECUTION

3.1 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.2 WARNING AND INFORMATION LABELS INSTALLATION

- A. Inscribe required message on, and attach warning/information labels where indicated.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels as follows:
 - 1. Markers shall be placed on piping at 20 foot maximum intervals. In addition, wherever a pipe passes through a wall, floor, or ceiling, it should be marked on each side of the wall, floor, or ceiling. Where pipe insulation or pipe is to be painted, it should be painted to match the background color of its contents (as indicated below). In addition to pipe marking, valves shall have brass tags indicating system and valve number.
 - 2. Piping shall have direction of flow arrows matching the legend and background colors adjacent to each marker and at branches.
- B. Colors for pipe marking systems shall be in accordance with ANSI standards.

3.4 DUCT LABEL INSTALLATION

- A. Locate duct labels as follows:
 - 1. Markers shall be placed on ductwork at 20 foot maximum intervals on bottom and most visibly accessible side. In addition, wherever a duct passes through a wall, floor, or ceiling, it should be marked on each side of the wall, floor, or ceiling. Where duct insulation or duct is to be painted, it should be painted to match the background color of its contents (as indicated below).
 - 2. Ducts shall have direction of flow arrows matching the legend and background colors adjacent to each marker and at branches.
- B. Colors for duct marking systems shall be as follows:

Duct System	Legend	Background
Supply	Black	Yellow
Return	Black	Yellow

<u>Duct System</u>	<u>Legend</u>	<u>Background</u>
Outdoor	Black	Yellow
General Exhaust	Black	Yellow
Toilet Exhaust	Black	Yellow

3.5 VALVE-TAG INSTALLATION

- A. Provide identification tags for valves including control valves and fire alarm valves; shutoff valves serving individual fixtures and equipment shall not be tagged.
- B. Provide valve charts in an approved location secured to wall.

END OF SECTION 230553

SECTION 230580 - ROOF CURBS AND RAILS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 General

- A. Ductwork, piping, equipment, fans, etc., which are roof mounted shall be furnished with equipment rails.
- B. Curb and rail type shall be compatible with roof.
- C. Duct and pipe penetrations through roof shall be furnished with curb.
- D. Furnish roof curbs and rails for sloping roofs with adjustments as required to level top of rail or curb.
- E. Refer to architectural drawing A800 drawings for all roof details. Furnished curbs shall be compatible with all architectural roof details.
- F. Curbs for the custom penthouse shall be furnished by the custom penthouse manufacturer and be designed specifically to properly support the units

PART 2 – PRODUCTS

2.1 PIPING CURB

- A. Refer to the architectural plans and specifications for all requirements to meet the owners standards.

2.2 DUCT CURB

- A. Refer to the architectural plans and specifications for all requirements to meet the owners standards.

2.3 EQUIPMENT RAILS

- A. Refer to the architectural plans and specifications for all requirements to meet the owners standards.

PART 3 - EXECUTION

3.1 GENERAL

- A. Curbs and associated equipment shall be installed under another division as per manufacturer's recommendations. Coordinate quantity and size of curbs with General Contractor prior to bidding.

END OF SECTION 230580

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes:
 - 1. Air Systems:
 - 2. Hydronic Piping Systems:
 - 3. Final Report.
 - 4. Final Inspection.
 - 5. Additional Adjustment.

1.3 QUALITY ASSURANCE

- A. Provide air and water system balancing and testing by an approved member of the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). The balancers must submit to the Architect a resume of experience, a sample of the forms to be used for the final report, and an inventory of the instruments to be used. Types, serial numbers and dates of last calibration of instruments used shall be listed in final balance reports.

1.4 WARRANTY

- A. Provide a guarantee on AABC / NEEB forms stating that AABC / NEEB will assist in completing requirements of the Contract Documents if the Testing Adjusting and Balancing (TAB) firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS

2.1 TEST HOLE CAPS

- A. Test holes shall be closed with caps suitable for duct static pressure scheduled.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. It shall be the TAB firm's responsibility to review the drawings and to notify the Engineer if additional valves and dampers are required to properly balance the various systems prior to the

installation of those systems. If the TAB firm reviews the drawings and does not notify the Engineer that additional valves and dampers are required, then the TAB firm shall be responsible to provide additional valves and dampers as required to properly balance the various systems at no additional cost to the Owner.

- C. Examine approved submittal data of HVAC systems and equipment.
- D. Examine system and equipment installations to verify that they are complete. Systems shall be cleaned, pressure tests completed and approved, and in continuous operation before balancing begins. Minimum continuous operation shall be 24 hours.
- E. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- F. Examine strainers for clean screens and proper perforations.
- G. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 GENERAL REQUIREMENTS FOR TESTING AND BALANCING

- A. Provide complete testing and balancing of each and every fan, trunk duct, branch duct, ducted outlet and return, coil, pump, water system and heat exchanger.
- B. Testing and balancing procedures on each system shall be performed in accordance with the procedures contained in the following:
 - 1. AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems"
 - 2. NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems"
 - 3. SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing"
- C. Provide test wells, and openings as required by the testing agency at no additional cost to the Owner.
- D. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed.
- E. Neatly mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, and similar controls and devices, to show final settings.
- F. Coordinate with the General Contractor to ensure proper balancing above inaccessible ceilings before the ceilings are completed.
- G. Final tests and adjustments necessary to demonstrate compliance with specified performance requirements for major items of equipment (such as boilers, air conditioning units and refrigeration machines) shall be directly supervised by the manufacturer's representatives.

- H. The Architect shall be notified in writing of the date and time of final balancing and testing activities. Notification must be received at least 48 hours in advance so that the Architect can be present if he so wishes.

3.3 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Minus 5 to plus 10 percent of design values.
 - 2. Air Outlets and Inlets: Minus 5 to plus 10 percent of design values.
 - 3. Heating-Water Flow Rate: Minus 5 to plus 5 percent of design values.
 - 4. Cooling-Water Flow Rate: Minus 5 to plus 5 percent of design values.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for air systems. Air systems and appurtenances shall be adjusted and balanced to deliver the air quantities as specified, indicated on the drawings, or as directed. Check the sum of required outlet volumes against required fan volumes.
- B. Check for proper sealing of air duct system and air-handling unit components.
- C. The system shall be set up to provide minimum design fresh air.
- D. The following shall be recorded for each air handling unit, and heat recovery unit if applicable, at the time of testing:
 - 1. Outdoor temperature, date, and time.
 - 2. Condition of filter (change if dirty).
 - 3. Cooling coil condition (wet/dry).
- E. The following data shall be recorded for each fan system:
 - 1. Fan and motor RPM.
 - 2. Motor current and voltage.
 - 3. Fan, coil and filter static pressures.
 - 4. Name plate data of fans and motors.
 - 5. Motor sheave, fan pulley, and belt sizes.
- F. Traverse the main supply, return, and exhaust ducts to determine CFM deliveries of the fan. If fan CFMs are not within specified tolerances, re-adjust fan speed by adjusting sheave or replacing pulleys, whichever is applicable, to obtain specified CFMs.
- G. After it has been determined that the fans are providing design CFMs at required static pressures, balancing of the outlets may proceed. Outlets shall be balanced at volume dampers and not at diffuser or register dampers.
- H. If the system is equipped with an economizer free-cooling system, the balancer shall traverse the main supply ducts with the system set at 100 percent outside air. If readings indicate more than a 5 percent variation in total air supply, the fans or dampers shall be readjusted. Volume dampers shall be permanently marked at the final balance condition.

- I. After completion of the system air balancing and acceptance of the final report by the Architect, a final recording of the following items shall be provided and posted at the supply fan unit under cooling design conditions:
 1. Outside temperature, date, and time.
 2. Filter S.P.
 3. Coil S.P. and air temperature entering and leaving coils.
 4. Suction S.P.
 5. Discharge S.P. and leaving air temperature.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS (Exhaust System)

- A. After the exhaust fan system has been adjusted and balanced to achieve the required static pressure, command the constant volume exhaust air terminal to the design exhaust flow rate.
- B. Adjust the controller "K" factor until the airflow value generated by the BAS / terminal controller matches the design air flow set point as measured by the balancer. When total airflow is correct, balance the air outlets downstream from terminal units to within the specified tolerances described above.
 - a. The "K" factor at the design flow rate shall be recorded and given to the controls contractor to be entered into the BAS.
 - b. If required modify the design flow and re-calibrate the air terminal with a new "K" factor as required to balance each space upstream of the air terminal.
 - c. Adjust the manual balancing damper downstream of the air terminal to allow the motorized damper in the air terminal to have an adequate damper range of modulation to allow for stable control.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. For variable-air-volume systems, simulate diversity as follows:
 1. When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 1. Measure fan static pressures to determine actual static pressure.
 2. Measure static pressure across each component that makes up an air-handling unit.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 3. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

- C. After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set the outside-air dampers at minimum and the return and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at the design / maximum airflow and adjust the controller "K" factor until the airflow value generated by the BAS / terminal controller matches the design / maximum air flow set point as measured by the balancer. When total airflow is correct, balance the air outlets downstream from terminal units to within the specified tolerances described above.
 - a. The "K" factor at the design flow rate shall be recorded and given to the controls contractor to be entered into the BAS.
 - b. Adjust patterns of adjustable outlets for proper distribution without drafts. Install additional baffles as required.
 5. Set terminal units at minimum airflow and adjust the controller "K" factor until the airflow value generated by the BAS / terminal controller matches the minimum air flow set point as measured by the balancer.
 - a. The "K" factor at the minimum flow rate shall be recorded and given to the controls contractor to be entered into the BAS.
 - b. Check air outlets for a proportional reduction in airflow.
 6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the air handling return dampers accordingly and balance the return-air ducts and inlets as follows:
 - a. Adjust the normally opened positions to act as balancing dampers to balance the return air flow between the atrium and the 4th floor. Record the positions and give the values to the controls contractor to be entered into the BAS.
 - b. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for water systems. Water systems and appurtenances shall be adjusted and balanced to deliver the water quantities as specified, indicated on the drawings, or as

directed. Modify pumps and/or controls to produce design flow. Check the sum of branch-circuit flows against associated pump flow rates.

- B. Check that hydronic systems are filled, clean, and free of air.
- C. Automatic flow control valves (or integral "autoflow" valve in Belimo PICCV valve) shall be used to balance water flow for terminal devices. Automatic control valves shall be set for full flow conditions during balancing procedure. Verify water flows at orifices located at branch mains as shown on the drawings. If flows are not within specified tolerances, adjust balancing valves.
- D. Calibrated balancing valves on all three-way valves shall be adjusted to equal the pressure drop across the coil to allow for constant flow.
- E. Air handling unit coils shall be balanced by automatic flow control valves. Each individual coil in a rack of coils shall be individually balance by adjusting the manual calibrated balancing valve to provide equal flow to each coil in the airhandling unit coil rack.
- F. Pump capacities shall be determined by differential pressure measurements. Water circuits shall be adjusted by balancing valves provided as part of the installation, and balancing valves shall be permanently marked after final balance is complete so that they may be returned to their correct position if disturbed. Pump balancing valves shall be adjusted to provide the lowest discharge pressure possible while maintaining flow to all devices.
- G. The following data shall be recorded for each water system:
 - 1. Pump motor current and voltage.
 - 2. Entering and leaving water flow rates, temperatures and pressures at coils, etc.
 - 3. Differential pressure across pumps.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS (Existing chilled water and heating hot water pumps)

- A. Measure water flow at pumps.
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within specified tolerances.
 - 5. The triple duty valve shall be 100% open when the balancing procedure is complete.

3.9 PROCEDURES FOR AIR COILS

- A. Measure the following data for each coil:
 - 1. Airflow.
 - 2. Dry-bulb temperature of entering and leaving air.

3. Wet-bulb temperature of entering and leaving air for cooling coils.
4. Air pressure drop.
5. Water Coils:
 - a. Water pressure drop.
 - b. Water flow rate.
 - c. Entering- and leaving-water temperature.
6. Refrigerant Coils:
 - a. Refrigerant suction pressure and temperature.

3.10 FINAL REPORT

- A. The HVAC Contractor shall obtain copies of the final Air Flow and Water Flow Balance and Test Reports from the balancing agency. Submit same to the Architect in accordance with the shop drawing submittal requirements for the Architect's evaluation and approval.
- B. The report shall be a typewritten or computer generated printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- C. Include a certification sheet in front of binder signed and sealed by a Registered Professional Engineer.
- D. Include a list of instruments used for procedures, their serial numbers, and proof of calibration.

3.11 FINAL INSPECTION

- A. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by the Architect.
- B. TAB firm test and balance engineer shall conduct the inspection in the presence of the Architect.
- C. The Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to 10 percent of the total measurements recorded.
- D. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- E. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- F. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
- G. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment to the HVAC Contract.

3.12 ADDITIONAL ADJUSTMENT

- A. If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting when the conditions occur.
- B. Provide an additional 25 hours or after occupancy adjustment. Adjustments shall include but not limited to diffuser rebalance, coil rebalance, pump rebalance and fan rebalance.

END OF SECTION 230593

SECTION 230600 - TAB COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. The purpose of this section is to specify the responsibilities and participation in the commissioning process.
- B. Work includes:
 - 1. Attend initial commissioning coordination meeting.
 - 2. Submit the TAB agenda and procedures to the Commissioning Authority for review and acceptance.
 - 3. Notify the Contractor on completion of the TAB work and on the submission of the TAB report.
 - 4. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Authority for verification or diagnostic purposes.
 - 5. Providing training for the systems specified to the Owner, with coordination by the Commissioning Authority

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. All testing and start-up procedures and documentation requirements are specified within Divisions 1, 23, 26 and related portions of this project.
- B. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.
- C. Division 23 Section "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.
- D. Division 23 Section "Commissioning of Integrated Automation" for commissioning process activities for integrated automation systems, assemblies, equipment, and components.
- E. Division 26 Section "Commissioning of Electrical Systems" for commissioning process activities for electrical systems, assemblies, equipment, and components.

1.3 SUBMITTALS

- A. Provide a daily copy of TAB data collected by the TAB technician.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide standard and specialized test equipment as necessary to test the mechanical equipment.
- B. Proprietary test equipment, including hardware, software, and specialized test instruments required by the manufacturer for system testing and commissioning whether specified or not, shall be provided by the Contractor.

PART 3 - EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

- A. Developing and witnessing the Commissioning process is the responsibility of the Commissioning Authority.
- B. Performing the Commissioning is primarily the responsibility of the Contractor, with support for start-up, testing, and commissioning testing.
- C. The commissioning process does not relieve this Contractor from participation in the process, or diminish the role and obligations to complete all portions of work in a satisfactory and fully operational manner.
- D. Complete all phases of work so the system can be commissioned for beneficial use by the Owner.
- E. A commissioning plan will be developed by the Commissioning Authority. The commissioning plan will be developed prior to completion of the installation. The Contractor shall review the commissioning plan and comply with the requirements.
- F. Commissioning is intended to begin upon completion of a system. Commissioning may proceed prior to the completion of systems and/or sub-systems, if expediting this work is in the best interests of the Owner. Commissioning activities and schedule will be coordinated with the Contractor. Start of commissioning before system completion will not relieve the Contractor from completing those systems as per the schedule.

3.2 PARTICIPATION IN COMMISSIONING

- A. Submit daily copies of the "pencil" forms of the TAB work performed.
- B. Provide skilled technicians to verify any selected measurement from the TAB report if required for diagnostic purposes. Work schedules, time required for testing will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technicians(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and problem resolutions.
- C. System problems and discrepancies may require additional technician time, Commissioning Authority time, redesign reconstruction of systems, and the system components. The additional technician time shall be made available for the subsequent commissioning periods until the required system performance is obtained.
- D. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system and sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment and an attitude and willingness to work with the Commissioning Authority to get the job done.

3.3 WORK TO RESOLVE DEFICIENCIES

- A. In some systems, misadjustments, misapplied equipment, and deficient performance under varying loads will result in additional work being required to commission the system. This work will be completed under the direction of the Architect with input from the Contractor, equipment supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Owner will have final jurisdiction on the necessary work to be done to achieve performance.

- B. Corrective work shall be completed in a timely fashion to permit the timely completion of the commissioning process. Experimentation to render system performance will be permitted. If the Commissioning Authority deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Authority will notify the Architect, indicating the nature of the problem, expedited steps to be taken, and the deadline for completion of activities. If the deadline(s) passes without resolution of the problem, the Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incur to solve the problems in an expeditious manner will be the Contractor's responsibility.

3.4 ADDITIONAL TAB RESPONSIBILITIES

- A. Additional TAB Contractor specific responsibilities for lab airflow control system include the following:
 - 1. On airflow tracking zones.
 - a. Balance all outlets downstream of VAV terminal. Record final settings.
 - b. Measure airflow at both minimum and maximum flow conditions and calibrate VAV flow signals at both extremes. Extremes of flow shall be established by putting the zone into full heating and full cooling and raising the fume hood sashes to the stop height and lowering them to the airfoil. Record all parameters and final flow coefficient if only one flow coefficient is available and this does not permit setting the range to within specified tolerances, enter the flow coefficient the average of the two required flow coefficients and report the deficiency in an Action item.
 - c. Measure and record supply airflow at flow extremes with reheat valves both open and closed as required above.
 - d. Report on pressure values observed between adjacent active pressure controlled rooms after systems are balanced and controlled to specified tolerances. After calibrating the VAV terminals and setting up the airflow offset to design values, measure and record the differential pressure across all doors and adjacent zones. If the pressure does not fall within 0.05 inch w.g. plus or minus 0.02 w.g. in the desired direction, report the resulting pressure in an Action Item.
 - 2. On hard Ducted Biosafety Cabinets:
 - a. Calibrate the Exhaust VAV Terminal airflow at design flow.
 - b. With the sash in standard position and the BSC fan off, measure the face velocity in a grid and adjust the airflow setpoint to obtain 100 fps+- 8fps.
 - 3. On Fume Hoods:
 - a. Calibrate the fume hood control airflow measuring device across the range of flow (minimum to stop height).
 - b. Coordinate with and assist control contractor to set up the hood to achieve proper face velocities.
 - c. Measure and record face velocities in a 12" grid with sash at specified stop height. If the individual face velocity reading differs by more than 15%, report the deficiency in an Action item. If the average face velocity is not 0.51 ms +- 0.05, notify contractor and adjust until face velocity is within tolerance

3.5 ADDITIONAL COMMISSIONING

- A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor, suppliers, and Commissioning Authority shall include a reasonable reserve to complete this work as part of the standard contractual obligations.

END OF SECTION 230600

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Adhesives and Coatings
 - 2. Duct Insulation Materials:
 - a. Rigid Insulation Board.
 - b. Flexible Glass Fiber Blanket.

PART 2 - PRODUCTS

2.1 GENERAL DUCT INSULATION REQUIREMENTS

- A. Unless specifically noted otherwise, insulation shall have composite fire and smoke hazard ratings (including insulation, jacket or facing, and adhesives), as tested by ASTM E84, NFPA 255 or UL 723 procedures, not exceeding a flame spread rating of 25 and smoke developed rating of 50.
- B. Asbestos shall not be used in the manufacture of insulation products.
- C. Testing of ductwork shall be complete before insulation on the exterior of the duct starts.

2.2 ADHESIVES AND COATINGS

- A. Manufacturers:
 - 1. Childers
 - 2. Foster
 - 3. Carlisle

	<u>Childers</u>
Vapor Barrier Adhesive	CP-85
Vapor Barrier Coating	CP-30
Lagging Adhesive	CP-52
Insulation Adhesive	CP-85
Glass Cloth Adhesive	CP-85
Weatherproofing Mastic	CP-10/11
Calcium Silicate Adhesive	CP-97

2.3 DUCTWORK INSULATION SCHEDULE

Duct System	Insulation Type	Minimum Insulation Thickness	Notes
Supply - Concealed	I-2	2 inches	
Supply - Exposed	I-2	1 inch	
Supply - Outdoors	I-2	2 inches	
Return - Concealed	I-2	1-1/2 inches	
Return - Exposed	I-2	1 inch	
Return - Outdoors	I-2	2 inches	
Outside Air - Concealed	I-2	2 inches	
Outside Air - Exposed	I-2	2 inches	
Outside Air - Outdoors	I-2	2 inches	
Sound Attenuators	I-2	1 inch	
Field Fabricated Plenums	I-2	1 inch	
Mixed Air - Concealed	I-2	1-1/2 inches	
Mixed Air - Exposed	I-2	1 inch	
Mixed Air - Outdoors	I-2	2 inches	
Exhaust and Relief	I-2	1 inch	

2.4 TYPE I-2 INSULATION

- A. Insulation shall be rigid insulation board, minimum density 6 pounds/cubic foot with factory applied foil-reinforced kraft vapor barrier jacket. Jacket shall be flame retardant. For round ductwork, provide sectional moulded type to 20 inches diameter, above 20 inches and for oval ductwork, rigid insulation board accurately scored to provide tight fit.
- B. Secure to duct with pins and speed washers. Pins shall be of sufficient length to prevent dimpling of the insulation. Areas subject to sagging including, but not limited to, undersides of ductwork shall be coated with insulation adhesive and secured in place with pins and washers as described above. Pins shall be 12 inches on center and 3 inches from edge. Provide additional pins and washers as required to prevent sagging.
- C. Lap ductwork at edges. Joints shall be sealed with 5 inch wide vapor barrier foil adhered with insulation adhesive or pressure sensitive foil tape. Seal vapor barrier openings, tears, punctures, etc., with tape or mastic to provide a vapor tight system.
- D. Manufacturers:
 - 1. Owens-Corning Fiberglas
 - 2. Knauf Insulation Board
 - 3. Manville 800 Series
 - 4. Certainteed IB Board.
- E. For ductwork exposed to weather, provide weatherproof finish. Installation of weatherproof finish shall be per manufacturer's recommendations.
 - 1. Manufacturers:

- a. Polyguard Products, Inc. - Alumaguard 60
- b. MFM Building Products Corp. - Flex Clad 400
- c. Ventureclad 1577 CW.

2.5 EXTENT OF INSULATION

A. Insulate the following:

1. Supply ductwork (except double wall duct which is internally insulated)
2. All Return ductwork in the interstitial space
3. Outside air ductwork
4. Return ductwork in equipment rooms, shafts, above ceiling spaces which are below roofs, crawl spaces, garages, and spaces without heating or air conditioning.
5. Outside air plenums
6. Supply side sound attenuators

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Insulation shall be applied on clean, dry ductwork.
- B. Install insulation with least number of joints practical.
- C. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- D. Provide insulation continuously through roof penetrations. Install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
- E. Install insulation continuously through sleeves and openings in penetrations that are not fire rated.
- F. Insulation shall stop at electric duct heaters. Ends of insulation shall be sealed and lapped with vapor barrier.
- G. For penetrations through fire-rated assemblies in systems utilizing acoustic duct lining, terminate lining at fire damper sleeves and externally insulate damper sleeve beyond to match adjacent duct lining. Overlap damper sleeve and duct lining at least 2 inches.
- H. Apply insulation in accordance with manufacturer's recommendations.

END OF SECTION 230713

SECTION 230719 - HVAC PIPE AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

B. Section Includes:

1. Adhesives and Coatings
2. Insulation Materials:
 - a. Glass Fiber
 - b. Calcium silicate.
 - c. Flexible elastomeric.
 - d. Removable
 - e. Phenolic.

PART 2 - PRODUCTS

2.1 GENERAL PIPING AND EQUIPMENT INSULATION REQUIREMENTS

- A. Unless specifically noted otherwise, insulation shall have composite fire and smoke hazard ratings (including insulation, jacket or facing, PVC covers, and adhesives), as tested by ASTM E84, NFPA 255 or UL 723 procedures, not exceeding a flame spread rating of 25 and smoke developed rating of 50.
- B. Asbestos shall not be used in the manufacture of insulation products.
- C. Piping tests shall be completed before insulation proceeds.

2.2 ADHESIVES AND COATINGS

A. Manufacturers:

1. Insulcousitc
2. Benjamin-Foster
3. Childers

	<u>Insulcousitic</u>	<u>Benjamin-Foster</u>	<u>Childers</u>
Vapor Barrier Adhesive	225	80-07	CP-54
Vapor Barrier Coating	501	30-35	CP-30
Lagging Adhesive	102	30-36	CP-52
Insulation Adhesive	225	85-20	CP-54
Glass Cloth Adhesive	225	85-20	CP-54
Weatherproofing Mastic	VI-AC	48-00	CP-10/11

2.3 DUCTWORK INSULATION SCHEDULE

- A. Piping systems shall be insulated in accordance with the schedule below, including flanges, fittings, valves, expansion joints, vents, drains and similar appurtenances. Piping subject to freezing shall be insulated with a minimum of 2 inch insulation.

Piping System	Insulation Type	Minimum Insulation Thickness	Notes
Chilled water piping (40°F to 60°F) and interior glycol system piping	P-1	1 inch for pipes 1-1/2 inches and below; 1-1/2 inches for piping above 1-1/2 inches in diameter	
Hydronic heating system	P-1	1 inch for pipes 1-1/2 inches and below; 2 inches for piping above 1-1/2 inches in diameter	
Domestic cold water make-up	P-1	1/2 inch	
Air conditioning condensate, control air piping 25 feet downstream of dryer	P-1	1/2 inch	
Refrigerant piping	P-1	1-1/2 inch for pipes 1-1/4 inches and above; 1 inch for pipes under 1-1/4 inches	
Refrigerant piping	P-5	1 inch for pipes 2 inches and above; 3/4 inch for pipes under 2 inches	

2.4 EQUIPMENT INSULATION SCHEDULE

Piping System	Insulation Type	Minimum Insulation Thickness	Notes
Chilled water pumps	P-4		
Chilled water expansion tanks and air separator	P-3	1-1/2 inches	Apply insulation in multiple layers with staggered seams
Deaerators	P-1	2 inches	
Hot water convertors (120°F and above)	P-2	2 inches	
Boilers	P-2	2 inches	
Breechings, stacks	P-2	2 inches	

Piping System	Insulation Type	Minimum Insulation Thickness	Notes
Hot water air separator	P-1	1 inch	
Hot water air separator	P-5	3/4 inch	

2.5 TYPE P-1 GLASS FIBER INSULATION

- A. Insulation, including fiberglass fitting inserts, shall be glass fiber with a maximum K factor of .24 at 75°F mean temperature with factory applied all-service jacket with self-sealing lip. Exposed pipe insulation material must be the one piece type. Sectional type may be used for concealed piping.
- B. Seal butt joints with 3 inch wide butt stripe adhered neatly in place.
- C. Fittings and valves for all piping shall be insulated with preformed fiberglass inserts of the same density as the pipe insulation and finished with a PVC fitting cover. Provide one fiberglass insert per fitting or valve for each 1 inch of piping insulation specified. Field cut or loose blanket insulation is not acceptable.
- D. Fittings and valves for steam piping shall be insulated with fiberglass inserts and finished with .024 inch thick aluminum fitting flange and valve covers.
- E. Exposed piping outdoors shall be finished with a factory attached all-service jacket, protected with two 1/16 inch coats of Childers CP/10 or CP/11 weather barrier coating.
- F. Exposed piping in finished spaces shall be protected with .024 inch thick stainless steel or aluminum jacketing and fitting covers.
- G. Manufacturers:
 - 1. Owens-Corning SSL-11
 - 2. Manville Micro-Lok
 - 3. Knauff ASJ-SSL
 - 4. Certainteed Alley-K

2.6 TYPE P-2 CALCIUM SILICATE BLOCK INSULATION

- A. Insulation shall be 11 pounds per cubic foot density molded asbestos-free hydrous calcium silicate with a K factor of 0.38 at 200°F mean temperature. Insulation shall be fastened in place with adhesive as per manufacturer's recommendations and 16 gauge copper-clad wire on 9 inch maximum centers. Fill joints with insulating cement.
- B. Provide 1 inch galvanized wire mesh on insulated surfaces. Secure and provide tight. Apply 1/4 inch thick finishing cement. Use corner beads for a smooth finish where insulation is terminated.
- C. For insulation outdoors, provide 0.024 inch thick stainless steel jacket banded, overlapped, secured with pop rivets or screws, and sealant placed on joints as per manufacturer's recommendations for a watertight finish.
- D. Manufacturers:

1. Owens-Corning calcium silicate insulation
2. Manville Thermo-12
3. Knauff Temperlite 1200
4. Certainteed Calmax

2.7 TYPE P-3 FLEXIBLE LASTOMERIC INSULATION

- A. Insulation shall be AP Armaflex pipe insulation or approved equivalent. K factor shall be .27 at 75°F mean temperature. Insulation shall be fastened using manufacturer's adhesive with smooth side out. Seal joints with the same adhesive.
- B. Provide two coats of manufacturer's water resistant finish for interior insulation.
- C. For insulation outdoors, provide stainless steel or aluminum jacket, banded, overlapped, secured with pop rivets or screws, and sealants placed on joints as per manufacturer's recommendations for a watertight joint.
- D. Flame spread rating shall be 25 or less, and smoke developed rating shall be 50 or less for all thicknesses.

2.8 TYPE P-4 REMOVABLE INSULATION

- A. Provide removable insulation jacket for pumps indicated.
- B. Jacket shall be Teflon-coated fiberglass fabric with a 500°F temperature rating. Insulation shall be fiberglass with a temperature rating of 1,000°F. Jacket shall be noncombustible.
- C. Maximum K factor shall be .33 at 300°F.
- D. Manufacturers:
 1. Engineered Insulation Services
 2. Alpha Associates
 3. Mid-Mount Materials

2.9 TYPE P-5 INSULATION (PHENOLIC)

- A. Insulation, including two-piece molded fitting covers, shall be phenolic with a maximum K factor of .13 at 75°F mean temperature with factory applied all-service jacket with self-sealing lip. Exposed pipe insulation material must be the one-piece type. Sectional type may be used for concealed piping.
- B. Insulation shall be.
- C. Seal butt joints with 3 inch wide butt strip adhered neatly in place.
- D. Manufacturers:
 1. Kingspan Koolphen K
 2. Approved Equivalent

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Insulation shall be applied on clean, dry surfaces.
- B. Install insulation with the least number of joints practical.
- C. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- D. Insulation shall be continuous through construction openings and sleeves.
- E. Insulation on cold surfaces where vapor barrier jackets are required shall be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors and similar devices that are secured directly to cold surfaces shall be adequately insulated and vapor sealed to prevent condensation.
- F. For pipes handling fluids below 70°F, provide one of the following means of preventing contact between pipe insulation and hanger or support to prevent condensation:
 - G. High density rigid fiberglass insulation insert, equal in thickness to pipe insulation, with factory applied jacket and metal protection shield or saddle, between pipe and hanger or support.
 - H. Insulation protection shields or saddles of sufficient length and strength to support weight of pipe without crushing insulation and shaped to fit not less than half the pipe circumference.
 - I. For pipes handling fluids 70°F and above, rest pipe directly on hanger, insulate pipe and hanger.
- J. Provide insulation of instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Instrument connections shall be adequately insulated and vapor sealed to prevent condensation.
- K. Provide insulation continuously through roof penetrations. Install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
- L. Piping located on roof shall have 18 gauge stainless steel shield a minimum of 36 inches in length the full circumference of pipe. Locate where insulation will be stepped on due to maintenance traffic.
- M. Coordinate insulation installation with the installation of heat tracing. Comply with requirements for heat tracing that apply to insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Apply insulation in accordance with manufacturer's recommendations.

END OF SECTION 230719

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.
 - 2. Division 23 Section "Commissioning of Integrated Automation" for commissioning process activities for integrated automation systems, assemblies, equipment, and components.
 - 3. Division 23 Section "TAB Commissioning" for commissioning process activities for Testing, Adjusting and Balancing.
 - 4. Division 26 Section "Commissioning of Electrical Systems" for commissioning process activities for electrical systems, assemblies, equipment, and components.

1.2 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.3 CONTRACTOR'S RESPONSIBILITIES

- A. Review and comment on Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Perform commissioning tests at the direction of the CxA.
- C. Attend construction phase controls coordination meeting.
- D. Attend testing, adjusting, and balancing review and coordination meeting.
- E. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- F. Provide information requested by the CxA for final commissioning documentation.

- G. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.4 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Attend commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.5 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.
 - 8. Verification of testing, adjusting, and balancing reports.

1.6 SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The Contractor shall oversee and coordinate the HVAC&R Subcontractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor who shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 23 boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC&R shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - 2. Description of equipment for flushing operations.
 - 3. Minimum flushing water velocity.
 - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

- D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of gas systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 23 08 00

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The Uniform General Conditions, Supplementary General Conditions, and Division 1 of the Specifications apply to the work specified in this Section.

1.2 INTRODUCTION

A. Overview

- 1. This document contains the specification for a Direct Digital Control (DDC) system, also commonly termed the Building Automation System (BAS).

B. Instructions To Bidders

- 1. Base Bid – Include all work as described in the specification and drawings.

- C. It is the Owner's requirement that the DDC System Suppliers will bid all parts of the project. Failure to bid on any part of the project may result in bid being rejected.

- D. This document lists the requirements for the procurement of a DDC system for the entire project over a period of time.

- 1. The DDC System Supplier will have a contract directly with the Mechanical Contractor.

E. Approved DDC System Suppliers

- 1. Reliable and no others

1.3 STIPULATIONS

- A. Applicable requirements of the General Conditions and special requirements and Division 1 are part of this section and shall have the same force and effect as if printed here within full.

- B. In case of conflict between various requirements, the most stringent requirement shall apply.

- C. The complete construction documents package for the work that is included in this project's work is being provided. It is the bidder's responsibility to ensure that they have indeed received all of the documents as listed in this specification.

1.4 PURPOSE OF THIS DOCUMENT

- A. The purpose of this document is to obtain a lump sum price for the project.

- B. The technical requirements for the DDC System are generally included in this document. Failure by the bidder to adhere to these requirements may result in their bid being rejected.

- C. It is to be understood that the Owner is generally looking for the system as listed in this document. Any deliberate attempt by the bidders to "cheapen" the system by extensive use of

unitary controllers on large equipment (air handling units, heat exchangers, etc.) may render the bid as invalid.

- D. The Owners and Engineers, at their discretion, may ask for further information and/or clarification from the DDC supplier. Any written communication between the DDC System Suppliers and the Owner and/or Architect/Engineer may be included as part of the final contract between the Owner and the DDC System Supplier.
- E. If DDC system improvements occur between the time the of the existing installation and the time the Bid Documents are issued, and if these improvements require significant changes in the proposed system architecture, the Owner must approve such changes before the submission of the bids. Any system improvements or enhancements must be presented to the owner, whether the intent is to use the enhanced systems on this project or not.
- F. It is to be understood that the Owners are not obligated to accept the bid and the Owners reserve the right to reject the bid without explanation.
- G. All costs incurred by the DDC System Suppliers and their representatives for the preparation of the bid is their own responsibility. The Owner is not responsible for any of these costs.

1.5 REQUIREMENTS FOR SUBMITTING BIDS

- A. The bids must provide complete details for all equipment proposed sensors, hardware, software, and other equipment as specified. The material shall be carefully organized so that an accurate evaluation can be made.
- B. The schematic system layout shall show complete system architecture, including all digital control panels (DCPs) required. (It is to be noted that the installation drawings should show enough details so that an installation contractor can provide the wiring and labeling.) Show location of all DCPs, UCs, operator devices, etc. (This is to include the existing controller and workstation.)

1.6 DESCRIPTION OF PROJECT SITE

- A. Refer To General Conditions

1.7 ABBREVIATIONS

- A. Below is a list of abbreviations related to this project:

ACP	Apparatus Control Panel
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
AI	Analog Input
ANSI	American National Standards Institute
AO	Analog Output
ASME	American Society of Mechanical Engineers
AWG	American Wire Gauge
BI	Binary Input
BO	Binary Output
CFM	Cubic Feet per Minute
CPU	Central Processing Unit

CRT	Cathode Ray Tube
DCP	Digital Control Panel
DDC	Direct Digital Control
DE	Data Environment
DI	Digital Input
DO	Digital Output
DP	Differential Pressure
DPDT	Double Pole Double Throw
DPST	Double Pole Single Throw
DTC	Data Terminal Cabinets
EA	Exhaust Air
EIA	Electronic Industries Association
EMT	Electrical Metallic Tubing
EMS	Energy Management System
E/P	Electric/Pneumatic Transducer
EPROM	Erasable Programmable Read Only Memory
FCC	Federal Communication Commission
FPM	Feet per Minute
FV	Face Velocity
GPM	Gallons per Minute
HVAC	Heating, Ventilation and Air Conditioning
I&C	Instrumentation and Control
I/O	Input/Output
I/P	Current to Pneumatic
IEEE	Institute of Electrical and Electronic Engineers
ISA	Instrument Society of America
kWH	Kilowatt Hours
LAN	Local Area Network
MFA	Master Fire Alarm
N.C.	Normally Closed
NIP	Network Interface Panels
N.O.	Normally Open
NEC	National Electrical Code
OA	Outdoor Air
PDL	Peak Demand Limiting
P/E	Pneumatic/Electric
PLC	Power Line Conditioner
PUP	Non-Proprietary Public Unitary Protocol
PROM	Programmable Read Only Memory
RA	Return Air
RAM	Random Access memory
RH	Relative Humidity
RTC	Real Time Clock
RTD	Resistance Temperature Detector

SA	Supply Air
SWH	Service Water Heating
SPDT	Single Pole Double Throw
SPST	Single Pole Single Throw
TBG	Time Base Generator
UCP	Unitary Control Panel (also called application specific controllers or UC Controllers)
UL	Underwriter's Laboratory
VAV	Variable Air Volume

1.8 DEFINITIONS

A. Terms

1. (adj): This acronym is used for the word "adjustable". It is used in conjunction with the definition of an application parameter that resides in a Building Controller, Advanced Application Controller or Application Specific Device. Example: The hot water set point shall vary as a function of the outside air temperature. When the outside air temperature is 0 F (adj), the hot water set point shall be 180 F (adj). When the outside air temperature is 60 F (adj), the hot water set point shall be 100 F (adj). In this example, four variables have been defined as adjustable. When so defined, these variables must be exposed to the field bus as BACnet objects for viewing by a BACnet OWS.
2. Actuator: Control device to provide motion of a valve or damper in response to a control signal.
3. A/D Converter Resolution: The resolution of an analog to digital converter is the voltage range of the A/D divided by 2 to the X power where X is the number of bits for the A/D converter.
4. Advanced Application Controller: A controller with provisions for all of the physical inputs and physical outputs associated with a single mechanical component such as a terminal unit, air-handling unit, chiller or boiler. The controller shall also have embedded in it all of the control logic that is associated with the physical inputs to the physical outputs. A process controller may or may not have data management features such as time schedules, trend data storage and alarm message generation capabilities. These features may be provided by the Building Controller.
5. AI: Analog Input
6. Alarm Handling: The process by which the existence of an alarm condition results in the dispatch of an editable message to one or more operator workstations.
7. Algorithm Execution Sample Rate: How often a mathematical algorithm in a controller generates a new output value.
8. Analog: Continuously variable state over a stated range of values.
9. Analog Calibration Offsets: For all analog input measured variables, there is a requirement to adjust the value measured by the hardware based analog input point to match the value reported by a certified test instrument. An analog calibration offset is a parameter that can be added or subtracted from the raw value measured by the sensor to produce a calibrated value that will be use by the control logic and reported to the operator workstations. The initial value

of this parameter is set at zero and it is adjusted when the calibration process is executed. This adjustment is referred to as a single point calibration. These offset values are configuration parameters and as such shall be written to EEPROM. It shall be possible to change the value of these parameters without re-downloading the program to the controller.

10. AO: Analog Output
11. Application Programming Tool (APT): A software tool used to create control logic for use in a Building Controller or Advanced Application Controller (Process Controller or Supervisory Logic Controller). Application programming tools are unique to each vendor. Example: The Honeywell application programming tool cannot be used to create an application for downloading to a TAC programmable process controller. The use of open protocols does not impact this definition.
12. Application Specific Controller (ASC): A subset of application specific devices (ASD).
13. Application Specific Device (ASD): A sensor, controller, or end device that is pre-programmed by the vendor. It may have physical inputs and physical outputs. The control logic, while not programmable, may be configurable through the use of configuration parameters. The application may require input network variables and may send output network variables onto the network.
14. Approve: The term "approved," where used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in the Conditions of the Contract. Such "approval" does not release the General Contractor from the responsibility to fulfill the Contract Document requirements.
15. Approved equal: to be defined in the specification.
16. Archive: Long term storage of historical data. Archived data may be on the hard drive or relocated to disk or tape.
17. ATS: Automatic Time Schedules. Automatic time schedule software measures time and executes start and stop commands based on operator created requirements that are based on the day of the week or the date.
18. AWG: American Wire Gauge – Standard trade sizes of conductors
19. B-AAC: BACnet Advanced Application Controller
20. B-ASC: BACnet Application Specific Controller
21. B-BC: BACnet Building Controller
22. B-OWS: BACnet Operators Workstation
23. B-SA: BACnet Smart Actuator
24. B-SS: BACnet Smart Sensor
25. BACnet: Building Automation and Control Networks
26. BIBBS: BACnet Interoperability Building Blocks

27. Broadcasting: The propagation of data from a device to the control network. Software objects that broadcast data to the network may include the following parameters:
- a) Send on Delta: An adjustable parameter that defines a requirement to broadcast when the data generated by the software object changes by an amount that exceeds this parameter's value. For binary data, this parameter defaults to a change of state. The broadcast of data is initiated when this criteria and the minimum send time requirement have been met. Also referred to as a "Change of Value".
 - b) Minimum Send Time: An adjustable parameter that defines a mandatory time period during which no broadcasting of data will occur. Once this time period has been exceeded without a broadcast, the send on delta parameter or the maximum send time parameter shall determine when a broadcast is initiated.
 - c) Maximum Send Time: An adjustable parameter that defines the maximum time period between broadcasts of a software object's data to the network. Should the value of a software object remain constant over an extended period of time, the value will be rebroadcast once every maximum time period.
28. Building Controller: A device that includes IP to Field Bus router, automatic time scheduling, trend logging, alarm handling, and supervisory logic control functionality. Sometimes referred to as a BACnet Building Controller or B-BC.
29. Building Project Manager: is the Owner's manager for the particular building project.
30. Bus Topology: A term used to describe the sequential connection of devices on a LON segment. The communication cable runs from device to device with no tees or stubs from the main communication cable to a device. Also referred to as daisy chain wiring.
31. CAT: Category 5 Cable or Category 6 Cable – is an ANSI/EIA Standard 568 that specifies categories of twisted pair cabling systems (wire, junctions, and connectors) in terms of the data rates that they can sustain.
32. CFM: Cubic Feet per Minutes
33. Concurrent Personnel Training: is to mean adding one more trainee to the number of trainees specified. This trainee will be assumed to be added to the same training class as specified.
34. Configuration Parameter: An input variable to a device that is written to EEPROM. Configuration parameters can be changed from the OWS periodically but are not changed routinely as a function of control logic.
35. Control Room: the central station for the DDC system. This room shall also mean central control station, or central control center.
36. Coordination: the DDC System Supplier shall meet with the Engineer and Owner during the design stages of each building to coordinate the work of the DDC System installation
37. Data Server: A personal computer with a Microsoft's Sequel database for the storage of historical data. The historical data is sent to the data server by the system servers.
38. Data Storm: A data storm is the uncontrolled transmission of data from a controller to the network. It can consume bandwidth and prevent necessary data from getting through. It is typically caused by poorly written applications that do not use event driven communication

with minimum send times, send on delta (change of value), and maximum send time parameters.

39. Data Terminal Cabinets: this is a slave or extender panel to the DCP. This panel usually does not operate without being connected to the DCP.
40. Dead Zone: With respect the performance of a PID algorithm, the dead zone is the range of an input variable to the PID above and below the set point for which the output of the PID algorithm shall not be changed. Once the input variable gets within the dead zone, it is fruitless to attempt changes to get the input variable any closer to the set point. Assigning a dead zone to a PID loop improves stability and reduces wear and tear on the actuator.
41. DDC System Installer: the contractor who is to install all equipment, which is furnished by the specification. The DDC System Installer will provide all wiring, pneumatic tubing and conduit, which are required by the specification unless otherwise noted.
42. DDC System Manufacturer: this term shall mean the same as DDC System Supplier and vice versa.
43. DDC System Project Manager: is the main contact person who is employed by the DDC System Supplier and is responsible for all DDC matters concerning this project.
44. DDC System Supplier: the contractor who is to furnish all equipment required by the specification.
45. DI: Digital Input. Also referred to as a binary input or discrete input.
46. Digital Control Panel: this is the highest level of equipment that is connected directly to the high speed local area network. The DCP may or may not have I/Os connected to it. (DCP is also referred to as NIP on the Construction Documents.)
47. Directed: Terms such as "directed," "requested," "authorized," "selected," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases. However, no implied meaning shall be interpreted to extend the Engineer's responsibility into the Contractor's area of construction supervision.
48. Discrete: Binary or digital state
49. DO: Digital Output. Also referred to as a binary output or discrete output.
50. Drift: When a sensor calibration is checked after a defined period of time (typically one year), the difference between the reported value and the measured value is defined as the drift. This measurement assumes that the sensor was calibrated at the beginning of the time period. If the measurement at the end of the time period is at a different value than the measurement at the beginning of the time period, an allowance for the conformity rating must be included.
51. Dynamic Data: Data in a field level device that periodically changes values due to the measurements from the physical environment or the execution of control logic.
52. EEPROM: Electrically Erasable Programmable Read-Only Memory (ROM) that can be erased and reprogrammed (written to) repeatedly through the application of higher than normal electrical voltage.

53. **Electronic Signature:** Electronic signature is a feature that supports certification under 21 CFR Part 11. When an operator that is signed onto a system takes an action such as changing a set point, the system requires the user name, password and a documented reason for the action before the action is allowed to take affect.
54. **Enforced Acknowledged Response:** When an alarm is acknowledged, the entry of the cause of the alarm, action taken to resolve the alarm state, and additional comments are required.
55. **Engineer or Architect:** the Project Engineer for various projects. For the DDC System project, the Engineer shall be Burt Hill. The term "Architect" shall be deemed to mean "Engineer" unless otherwise noted. The Engineer will be responsible for all work which is in design. It may be necessary for the DDC System Supplier to coordinate with the Engineer's subcontractors during design and construction.
56. **Event Driven Communication:** A term used to describe the propagation of data from a device to the network based on broadcasting rather than polling. The send on delta (change of value) parameter is used to define the event and the data propagation is further controlled by the minimum and maximum send time parameters.
57. **Existing:** "Existing" equipment or devices shall remain in service unless otherwise noted. All equipment that is not indicated as being existing shall be new.
58. **FC:** Failed close position of a control device or actuator. The device shall move to the closed position on a loss of the control signal or energy source.
59. **Firmware:** There are two types of software associated with a hardware device. The first element of software provides the underlying core functionality of the device. The second element is the application program that allows the device to execute a specific sequence of control. The first core element is typically revision sensitive and may be updated from time to time by the vendor to improve performance. This first element of software is called firmware.
60. **Floating Control:** Floating control is a control loop algorithm used for fast responding airside and waterside pressure and flow control loops. Defining a set point and a neutral zone creates a "floating" analog zone in units of the process variable. The neutral zone is split half above the set point and half below the set point. Whenever the process variable is within the "floating" zone, the actuator is left unchanged (stationary for tri-state actuators and at the current percent stroke for analog devices). The process variable is measured and the algorithm executed once for each sample rate. For tri-state devices, the sample rate is always 1 second. For analog devices, the sample rate will vary from 2 to 10 seconds (a tuning requirement). During the execution of the algorithm, if the process variable is above or below the "floating" zone, the instructions to the end device are changed. For tri-state devices they are put into motion. For analog devices, their percent stroke signal is either increased or decreased by a set amount (called the bump rate). One sample rate later the process is repeated. If the process variable has returned to within the "floating zone," a tri-state actuator is instructed to cease motion and an analog device will hold at the new percent signal sent on the last sample. If the process variable remains outside the "floating" zone, a tri-state device will continue in motion and an analog device will receive another "bump". With pressure based control loops, it is usually required to set the position of the control device to a fixed level for a period of time when the system is started. This will preclude a pressure spike in the first few minutes of operation. This is not required for flow control loops.
61. **Flyover:** When the linking object is "transparent", information about the link is viewable only when the operator moves the pointer over the transparent linking object. This process is called a "flyover". A transparent linking object might be placed over a bitmap picture of a

piece of equipment. When the operator moves the pointer over the picture of the piece of equipment the link is viewable and clicking on the link takes the operator to the graphic page for the piece of equipment.

62. Free Topology: A data wiring topology supported by LON that allows for loops, tees, y-connections, etc. When this topology is used, only one terminator of a specific design is required and allowable cable lengths are significantly reduced. Guidelines on the application of this concept are available from Echelon.com.
63. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
64. Gain: A term used with proportional control. Gain is 100 divided by the specified throttling range. See also the definition for throttling range. This term is sometimes referred to as the proportional gain.
65. Graphic Page: A graphic page is a visual presentation in the operator workstation that allows the operator to view a collection of data in an organized manner. The data on a single view can come from multiple field devices. The data can be organized in a table format within the view. The data can be displayed on a visual representation of a mechanical system. Both visual equipment displays and columns of data can be displayed on single view. Links to other graphical pages can be displayed. Links to IP addresses can be displayed on a graphic page. A graphic page can be static such as a site map or picture with no dynamic data only links to other graphic pages.
66. Graphical Programming: Graphical programming is a concept where mathematical and logical algorithms are represented by graphical objects. Control logic is laid out by placing objects on a palette and connecting the output of one object to the input of the next object. Once completed, the object oriented diagram is compiled and checked for errors, and when all errors have been eliminated, the program can be downloaded to a controller.
67. General: Basic Contract definitions are included in the Conditions of the Contract.
68. High Volume Accumulator: Given the physical difficulty in measuring the static pressure of the outside air, the static pressure sensor is installed in a fabricated device that is made of a section of PVC piping. The pipe has multiple holes drilled in it to allow the interior of the pipe section to represent the static pressure without the effects of wind pressures. The sensor is installed in one end and the holes are drilled at all angles near the opposite end of the pipe. Both ends are capped.
69. Historical Trend Data: Trend data is a collection of values from a specific variable in a field bus level device such as the mixed air temperature on an air-handling unit. The collection of this data may be accomplished whenever the AHU is operating and then once every five minutes. This collected data is then stored in a database on a data collection computer. Once the data is removed from the device and placed in the database, it is considered to be Historical Trend Data.
70. HOA: Hand-Off-Auto
71. HVAC: Heating, Ventilating and Air Conditioning
72. HZ: Hertz, a unit of frequency. It is synonymous with cycles per second.
73. I/O: Input and Output

74. IEEE: Institute of Electrical and Electronics Engineers
75. Inch-Pound Units: A system of units used in the United States as contrasted with the SI system of units. See the ASHRAE Handbook of Fundamentals for a complete list of engineering units under this system of units.
76. Indicated: The term "indicated" refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
77. Inhibit Alarms: To inhibit an alarm is to stop the transmission of the alarm message to the OWS. This may be done on chilled water plant during the winter or during major maintenance on a system when the alarms no longer have any real significance. Also referred to as disabled alarms.
78. Initial Value (IV): An initial setting for a parameter that can subsequently be changed by the operator without re-compiling and downloading the program.
79. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
80. Instance Number: A unique number in the range of 0 to 4,194,302 assigned to each device in a BACnet system. A conflict in the instance number between two devices can be problematic. This is part of the BACnet addressing scheme for devices.
81. Internetwork: refers to the DDC control system's LAN, including all building networks, the campus network, and all associated equipment and cabling.
82. Interstitial Space: The space above a ceiling and below the above floor. Ductwork, piping and electrical cables are typically run in this space.
83. ISA: Instrumentation, System and Automation Society
84. Key Contact: a person designated by the Owner to closely work with the DDC System Supplier. This person may eventually administer the DDC system at the Owner's facility.
85. Labor: in the Bid Form, labor by the DDC System Supplier shall include all engineering, custom software programming, submittals, coordination, supervision, checkout, start-up, testing, service and maintenance, and warranty services. It will include all work, training and administrative tasks required by the specifications.
86. Latch: A term used in describing control logic where a state change by a binary variable causes another point in the logic to change states and remain at the new state even though the initiating variable reverts to its original state. Latching functions include a reset function that allows the latched variable to revert to its original state when the reset input is toggled.
87. Later Personnel Training: is to mean that one additional trainee is to be trained by special arrangement, outside of the regular schedule of training as specified.
88. Line Programming: Line programming based application programming tools use line code that is similar to FORTRAN, Basic or C+ programming. Master programs and subroutines are

created to meet a sequence of control. The program is then compiled and downloaded to a controller.

89. Links: A link is a mechanism by which the system operator can change the operator workstation view from one part of the system to another part of the system or from one graphic page display to another graphic page display.
90. Local Area Network (LAN): means the network which connects all of the DCPs. The operator controls may also be connected to LAN. This network is usually an industry standard network such as Arcnet or Ethernet.
91. Logic Generated Application Parameter: An application parameter for a control process that is generated by secondary or supporting logic. Example: A proportional plus integral (PI) control loop is used to control a chilled water coil in an Air Handling Unit. The process variable is the discharge air temperature. The set point for the PI control loop is a function of the maximum terminal load from all of the terminals being supported by the AHU. The PI control loop set point is a Logic Generated Application Parameter. If in the sequence of control, a Logic Generated Application Parameter is appended with (rpt), the value of the Logic Generated Application Parameter shall be an output network variable from the control device.
92. Lump Sum Work: is the work that is required to be done as part of this Document. This work includes the work associated with various packages as described.
93. Manual Control: A concept where the operator, from the operator workstation, takes control of an end device and forces a specific position or state. From a software perspective, the value produced by the control logic is not allowed to affect the position or state of the end device. The manual mode and the desired manual position or state, are parameters that are set by the operator.
94. Maximum Send Time Parameter: A parameter used to ensure the periodic update of network data. If a time period equal to the value of this parameter has expired without a broadcast of the variable, a re-broadcast of the current value shall be executed. See also send on delta (change of value) and minimum send time parameter definitions.
95. Minimum Send Time Parameter: A parameter used to control unnecessary broadcasting of data onto the network. A broadcast of an updated value shall not occur unless a time period equal to the value of this parameter has expired. The expiration of the time period does not mandate a re-broadcast. See also send on delta and maximum send time parameter definitions.
96. Modulating: Movement of a control device through an entire range of values proportional to an infinitely variable input value.
97. Multiple Controller Integrated Control (MCIC): A concept where multiple controllers with I/O are used to control a single mechanical system such as an air-handling unit. Under this concept, the mechanical system is sub-divided into a collection of processes to be controlled such as the fan start stop circuit, the fan variable speed drive, the mixed air section, the cooling coil section, etc.
98. NC: Normally Closed. Refers to the position of a switch or end device when the control signal is removed. Switch or device shall be closed.

99. Network Number: Each unique element of the system architecture is assigned a network number as part of the addressing scheme for a BACnet system. The IP layer has a network number. Each field bus has a network number.
100. NO: Normally Open. Refers to the position of a switch or end device when the control signal is removed. Switch or device shall be open.
101. Owner: Montgomery College
102. Owner's DDC System Coordinator: is the lead contact of the Owner for the DDC system for construction projects. This person will interface with the Owner and the DDC System Supplier.
103. Owner's Lead Contact: is the Owner's main contact for the DDC system project. This terminology shall be assumed to mean the same as paragraph GG (above).
104. OWS: Operator Workstation. With BACnet systems and operator workstation is also referred to as a BACnet OWS.
105. P: Proportional only control
106. Package: a portion of the project with specific starting and ending periods. Generally, a package will begin with a letter to the contractor (DDC System Supplier) signed by the Owner. The package will end with the Owner's beneficial occupancy of the space. Once the Owner has taken beneficial occupancy of the space, the warranty period for the work provided under that package will begin.
107. PI: Proportional plus integral control.
108. PICS: Protocol Implementation Conformance Statements.
109. PID: Proportional plus integral plus derivative control.
110. Point: defined as a hardware I/O to the DDC system. Each hardware point shall occupy a maximum of one wiring termination in a DCP, DTC, or UCP. Each UCP connection to a DCP shall be considered one hardware point.
111. Process Control: Process Control consists of a control loop such as PID that requires a process variable (measured by a sensor), the logic of control (PID) and an end device to be commanded. The logic of control may require numerous application parameters that may be fixed, adjustable from the OWS, or the output of secondary control logic.
112. Process Control Sample Rate: The time between updates of a newly calculated command to an end device.
113. Process Variable Sample Rate: The time between updates of measured values as measured by physical sensors.
114. Project: the scope of the total project includes all DDC work, which will be required for a specified period from the execution of the contract. Extensions or reductions in the project scope must be mutually agreed upon by the Owner and the appropriate contractors.
115. Project Engineer-Future Projects: is to mean the engineers working on future projects not included in this document.

116. Project Site: is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
117. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."
118. Real Time Trend Data: Trend data is a collection of values from a specific variable in a field bus level device such as the mixed air temperature on an air-handling unit. An operator workstation may poll for the value from the field device and immediately present the data in a graphical format for system troubleshooting. This type of trend data collection and presentation is called Real Time Trend Data. It is a temporary form of data collection used for periodic troubleshooting of a system problem. It is not used on a continuous basis, as excessive polling from a workstation is a poor steward of network bandwidth.
119. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
120. Repeater: A physical device used to connect two segments. A repeater does not filter any message traffic. A repeater does isolate physical problems such as short circuits to a single segment and is typically required to allow the use of additional devices or additional cable length.
121. Rolling Average: An algorithm that eliminates spikes in a variable. Parameters required for a rolling average are the specified time period and the sample rate of the algorithm. When the rolling average variable is updated, the previously calculated rolling average value is multiplied by the time period less the sample rate and then added to the current value of the process variable times the sample rate. This sum is then divided by the time period. The result is the new rolling average value.
122. (rpt): An acronym indicating data to be reported for viewing at the OWS.
123. Sample Rate Support: The term, sample rate, refers to how often an algorithm is executed. An engineer may wish that a PID algorithm controlling the mixed air damper calculate a new command to the damper once every 25 seconds. The 25 seconds is the sample rate. Sample Rate Support refers to the ability to control the sample rate for any given algorithm.
124. Send on Delta Parameter (Change of Value): A parameter used to control unnecessary broadcasting of data onto the network. A broadcast of an output variable shall not occur unless the output variable has changed by an amount equal to or greater than the value of this parameter and the minimum send time has expired since the last broadcast. See also minimum send time and maximum send time parameter definitions. For binary data, the send on delta parameter is assumed to be a change of state. Logic to support the send on delta concept may be imbedded in the configurable structure of an output point or programmed as part of the logic.
125. SI Units: A system of units based on the metric system. See the ASHRAE Handbook of Fundamentals for a complete list of engineering units in this system.
126. Software Point: defined as any hardware point or point created within the system using a calculation or data manipulation.

127. SQL: Structured Query Language. A standard interactive and programming language for getting information from and updating a database via queries.
128. Stand-Alone Controller: A stand-alone controller has provisions for all of the physical inputs and physical outputs associated with a single mechanical component such as a terminal unit, air handling unit, chiller or boiler. The controller shall also have embedded in it all of the control logic that associated the physical inputs to the physical outputs. A stand-alone controller will also have data management features such as time schedules, trend data storage and alarm message generation capabilities.
129. State Descriptors: DDC devices work in the world of binary numbers. When a binary value is displayed at the OWS, state descriptors can be appended to the data such that the operator shall see the English words rather than the binary values. Example: 0= OFF, 1= ON or 0= STOP, 1= START.
130. Sub-LAN: the network wiring for connecting UCPs. There could be several sub-LANs under a DCP.
131. Supervision: the DDC System Supplier shall work with the DDC System Installer to obtain the final product, an operating DDC system. The DDC System Supplier shall provide sufficient supervision of these installers to ensure the work is installed without delay.
132. Supervisory Logic: Control logic that does not directly rely on physical inputs or physical outputs as does process control. Supervisory Logic uses data from multiple process control loops, applies defined logic to the collection of data and generates instructions to process control loops. Example: Collect the damper positions from 25 VAV controllers. Determine the highest value. When the highest value is at 50%, send a static pressure set point of 1.0 inches of water (adj) to the air handling unit controller. When the highest damper position is at 90%, send a static pressure set point of 1.5 inches of water (adj) to the air handling unit controller. Supervisory Logic may be executed in Building Controllers or Advance Application Controllers.
133. System Messages: A message in the event log or alarm viewer that is generated within the OWS and not from a binary indicator broadcast from a controller.
134. TCP/IP: Transmission Control Protocol/Internet Protocol. A basic communications protocol in a private network, either an intranet or an extranet.
135. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report and interpret the results of those inspections or tests.
136. Terminator: An electronic component that consists of a resistive and capacitive circuit specifically designed to enhance the quality of communications on a segment.
137. Test Instrument Certification Data: Test instruments are used to measure analog variables in order to effect the calibration of the analog sensor. Test instruments must be periodically re-calibrated by an instrument calibration laboratory to ensure accurate measurements. Re-certification shall be every 12 months unless otherwise specified by the manufacturer of the instrument.
138. Test Mode: A concept where the operator from the OWS can interrupt the flow of data from a sensor to the control logic and insert a mandatory test value or test state to be used by the

control logic. The test mode and the desired test value or state, are parameters that are set by the operator.

139. Throttling Range (TR): A term used with proportional control. It is the amount of change in the process variable that will cause the proportional loop output to change by 100%.
140. Transmitter: A transmitter is a device that measures a process variable such as temperature, pressure or relative humidity and generates a corresponding electrical signal such as 0 to 10 VDC or 4 to 20 milliamps for input to a controller.
141. Trend Chart: A trend chart is the graphical presentation of trend data. A trend chart can be associated with real time trend data or historical trend data.
142. Trend Logs: A trend log is a collection of samples from a specified variable that are stored within a device on the field bus. This data will be periodically sent to the data server for long term storage and reports.
143. Trend Logging: The process of sampling and storing periodic values from the same variable at specific time intervals. The samples are stored at the device level and periodically uploaded to the data server where they become historical trend data.
144. Tuning Parameters, Floating Control: For floating control, the tuning parameters shall consist of the set point, neutral zone, sample rate, bump rate, shut down value, start up time and start up value. The action of the floating control loop, direct or reverse shall be hard coded to meet the needs of the application.
145. Tuning Parameters, PID Control: For PID control, the tuning parameters shall consist of the set point, loop throttling range, sample rate, integral time constant or integral gain, and derivative time constant or derivative gain, dead zone and shut down value. The action of the PID control loop, direct or reverse shall be hard coded to meet the needs of the application.
146. UL: Underwriters Laboratory
147. Unitary Control Panel" (UCP or UC): means the application specific controllers. These panels can provide stand-alone operation. Some of these panels may be configured for use with specific equipment while others will be programmable for custom applications. Units may have universal inputs/outputs.
148. University Points or I/O: means that all of the points that connect to the DCP, UCP/UC, or DTC are user definable; there are no fixed inputs or outputs (digital or analog).
149. UPS: Uninterruptible Power Supply. A device that allows your computer to keep running for at least a short time when the primary power source is lost. A UPS contains a battery that provides power when the primary power source is lost.
150. Validate: A term used in concert with calibration and sequence of control performance verification. To validate is to verify that processes have been executed and the results are within defined standards.
151. VAV: Variable Air Volume
152. VFD: Variable Frequency Drive

153. Web Server: A software package installed on a desk top computer that provides for operation access to the Enterprise Level EMCS system from a computer on the TCP/IP network, using only a browser.

154. Work: all labor and equipment provided under a specific contract.

1.9 DRAWING GRAPHICS AND CONTENT

- A. Graphics employed on the drawings are those recognized in the construction industry. Those used in mechanical and electrical contexts are generally those recommended by ASHRAE, ASME, ASPE, ISA and IEEE. Refer any uncertainty to the Engineer for clarification before proceeding.
- B. The manner in which the drawings are organized or titled does not intend any group for trade union or subcontract purposes.

1.10 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with the standard as stated. If not referenced by date, comply with that in effect as of the date of the Agreement.
- C. Conflicting Requirements: Where compliance with two or more standards is required and they establish different or conflicting requirements for minimum quantities or quality levels, the most stringent will be enforced. Refer requirements that are different, but apparently equal, and any other uncertainties to the Engineer for a decision before proceeding.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level indicated shall be the minimum provided. The actual installation may comply exactly with the minimum specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are either minimum or maximum, as appropriate for the context. Refer uncertainties to the Engineer for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Copies of standards for the performance of a required construction activity shall be obtained directly from the publication source. These standards, along with any referenced code, are to be available at the Project Site for reference.
- E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the

context of the text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.

1.11 GOVERNING REGULATIONS/AUTHORITIES

- A. The Contractor should contact those authorities having jurisdiction for data and clarification regarding the Contractor's responsibilities to the Work.
- B. Trade Union Jurisdictions: As related to the construction activities, maintain complete current information on jurisdictional matters, regulations, and pending issues. Assign activities in a manner that will not unduly risk disputes, delays, claims and/or losses. Discuss new developments at the Project Meetings at the earliest date.

1.12 SUBMITTALS

- A. Permits, Licenses, and Certificates: Submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.
- B. Schedule of Standards and Codes: Submit a listing of the standards and codes that will be maintained at the Project Site. Once accepted, provide a copy of this listing to each subcontractor and supplier.

1.13 GENERAL DESCRIPTION OF PROJECT WORK

- A. This division of the specification covers execution of the direct digital control (DDC) system work.
- B. This division of the specification is divided into six (6) parts to facilitate indexing and referencing.
- C. The DDC system shall be furnished by the DDC System Supplier
- D. The DDC System Supplier shall supervise the DDC system installation to ensure that the installation is completed in a workmanlike manner and to satisfy himself that all work has been installed correctly so that he can provide a complete warranty for the system.
- E. In all cases where a device or equipment item is referred to in the singular, such reference shall apply to as many such items as are required to complete the installation.
- F. The following paragraphs outline the work which will generally be performed by the DDC contractors under most circumstances.
- G. The work covered by this specification consists of furnishing all engineering, coordination, supervision, start-up and testing services, training, necessary coordination with the owner, the contractor, equipment, accessories, and materials, and complete the installation of the DDC system in strict accordance with this specification and applicable drawings. Where the sequence of control for an equipment item or system has not been specifically addressed, the industry standard operation sequence shall be provided. If this is the case, the DDC System Supplier shall amplify or explain in detail what is being provided. The work by the DDC System Supplier generally includes the following:
 - 1. Provide a complete DDC system as described herein. The system shall be an integrated, easy-to-operate, flexible, microprocessor-based or desktop microcomputer-based direct

- digital control system for control of heating, ventilating, and air conditioning, as well as space pressurization. The DDC system shall be completely factory programmed, including all color graphics and report tables, and ready for operation.
2. The proposed system shall include any software required to program the proposed controllers. This software shall reside on the PC's. connected to the network and be configured such that any remote operators console can be used to program any of this DDC systems controllers connected to the network anywhere in the system. All scheduling, alarming, trending, and graphical user interfaces shall be accomplished through the system.
 3. Provide the automatic temperature control system including all sensors, actuators, end devices, display devices, stand-alone local control panels, network subsystems, all communication and application software, all power and control wiring and all computer equipment consoles required by the drawings and the specifications.
 4. Provide hardware and software complete with all engineering, documentation, start-up/commissioning, calibration, testing, trouble shooting, field service, training, and warranty as described herein.
 5. Provide electronic sensors for all major HVAC equipment and for other equipment as herein described.
 6. Provide a complete set of submittals as described herein.
 7. Provide complete start-up and testing services as herein described.
 8. Provide training to the Owner as herein described.
 9. Provide Owner's Manual, complete operating instructions and spare parts lists as herein described.
 10. Provide a minimum two-year full service parts and labor warranty on all control components. Provide a minimum five-year full service parts and labor warranty on DCP, operator interfaces, servers, and any other interface device.
 11. Provide five-year operating system upgrades.
 12. Furnish the specified number and types of spare parts to maintain critical operation.
 13. Provide and closely supervise the DDC system installation to ensure that the installation is completed in a workmanlike manner and to satisfy himself that all work has been installed correctly so that he can provide a complete warranty for the system.
 14. Provide automatic air dampers, complete with pneumatic or electronic actuators as specified. Provide valves with valve actuators as specified.
 15. Provide all unitary application-specific control panels and actuators. Coordinate with the Owner.
 16. Coordinate work with the work of each and every party involved in the project.
 17. Provide other work that is required for a complete and operating DDC system, which is not specifically called out.

H. Qualifications of DDC System Supplier

1. The DDC System Supplier shall have been involved with the development and the supply of similar equipment for at least five (5) years.
2. The DDC System Supplier or his representative shall have played a major role in the operation and testing of the proposed equipment type at the factory or a test facility.
3. The DDC System Supplier and his representatives shall each have a successful track record of installations using the type of equipment described herein. The proposer shall be able to submit a minimum of 10 completed projects of similar size, design, and complexity. These systems shall serve as references regarding the system and the performance of the DDC System Supplier's capability and performance.
4. The DDC System Supplier and his representative shall have in-house engineering and service personnel experienced in implementing this type of project. The engineering and service technicians assigned to the project shall have a minimum of five years of

experience in systems of this type. The DDC System Supplier shall submit for approval, the resume of all personnel to be used on the project.

1.14 IMPERATIVE LANGUAGE USED GENERALLY IN THE SPECIFICATION

- A. Except as otherwise indicated, the requirements expressed imperatively are to be performed by the contractor. For clarity of reading at certain locations, contracting subjective language is used to describe responsibilities, which must be fulfilled indirectly by the contractor, or when so noted, by others.

1.15 BIDDER'S INITIATIVES

- A. The DDC System Suppliers must provide a bid for the system as specified. Deviations from the specification in quoting the bid prices may render the bid invalid.
- B. If the DDC System Suppliers have suggestions or value engineering alternatives, the same should be listed along with the price, in the Bidder's Initiatives Supplement to the Bid Form.

1.16 DDC SYSTEM SUPPLIER'S LEAD PERSON

- A. The lead person is the main Project Engineer who will be the DDC System Supplier's main contact with respect to the project. It is intended that he will not have to confer with the DDC System Supplier's branch manager on most details.
- B. The lead person is expected to have several years' experience with the DDC System Supplier whom he represents.
- C. The Owner will have the option to approve the lead person, whose resume shall be submitted with the proposal, or to reject him. Should the Owner reject the proposed lead person, the DDC System Supplier shall offer another lead person who meets the Owner's approval at no additional cost to the Owner.
- D. During the course of the project, the Owner will have the right to request that the lead person be replaced because of failure to perform. This person will then be replaced with another lead person who meets the Owner's approval at no additional cost to the Owner.
- E. "Failure to perform" would include, but not be limited to, the following:
 - 1. Not fulfilling his lead person functions.
 - 2. Failing to be able to act independently of the branch office on most matters.
 - 3. Failing to respond to any and all matters on a timely basis.
 - 4. Failing to get the DDC system operating properly.
- F. Lead person primary functions shall include the following:
 - 1. Act as primary contact person for all matters relating to project, schedule, technical matters, billing and administrative problems.
 - 2. Attend construction meetings for the various work packages for which the DDC system supplier has a contract with the Owner.
 - 3. Provide lead engineering for and review all technical submittals for the initial project and future work packages.
 - 4. Prepare testing plans and procedures.
 - 5. Prepare training agenda.
 - 6. Attend kick-off meeting for new projects involving the DDC system.

7. Coordinate, review and approve all DDC system engineering work for conformance to specification, conformance to material standard requirements and conformance to budget requirements.
 8. Prepare updated unit pricing annually and review the updated pricing with appropriate Architect/Engineer and Owner representatives, as required.
 9. Coordinate work with the Architect/Engineer and Owner.
 10. Review and approve all project billings.
 11. Coordinate all work being performed by all Engineers and installation supervisors provided by the DDC System Supplier under this contract.
 12. Coordinate new DDC system works with the existing DDC system work by coordinating with the Owner's maintenance personnel.
 13. Work with the Engineer on the design of control systems for scope changes.
 14. Be responsible for accurate installation of all equipment.
- G. The lead person will be responsible for supervising all installation work and as such may be supported by the DDC System Supplier with additional personnel to fulfill those duties at no additional cost to the Owner.

END OF PART 1

PART 2 – GENERAL COORDINATION AND ADMINISTRATION

2.1 SCOPE OF THIS SECTION

- A. This specification covers the general requirements for project coordination and administration of the DDC System project for the work related to the entire project, as well as individual packages. This part also describes the general requirements for system installation, start-up, testing, submittals, etc.
- B. For various packages described in this document and all future DDC System packages, requirements for that building package shall apply. In case of two conflicting directions, the most stringent requirement shall apply.

2.2 ABBREVIATIONS AND DEFINITIONS

- A. See Section 15975/Part 1, 1.6 and 1.7 for Abbreviations and Definitions respectively.

2.3 APPLICABLE STANDARDS AND PUBLICATIONS

- A. The standards and publications listed hereafter form a part of this specification to the extent referenced. The publications are referred to in the text by their abbreviated designation only. Other publications, codes, and standards may also be applicable.

1. Federal Communications Commission (FCC) Rules and Regulations:

Part 15	Radio Frequency Devices (Vol. II, July 1981)
Part 68	Connection of Terminal Equipment to the Telephone Network (Vol. X, July 1977)

2. American National Standards Institute (ANSI) Publications:

C2-1987	National Electrical Safety Code
C62.41-1980	Guide to Surge Voltages in Low Voltage AC Power Circuits

C12.1-1982	Code for Electricity Metering and Correction Sheet
C57.13-1978	Instrument Transformers
ANSI/IEEE	Guide on Surge Testing for Equipment Connected
C62.45-1987	to Low Voltage AC Power Circuits
ANSI/IEEE	Recommended Practices for Establishing
C57.110-1986	Transformer Capability when Supplying Non-sinusoidal Load
	Currents
ANSI/ASHRAE	Standard 135-1995

3. American Society of Mechanical Engineers (ASME) Publications:

Fluid Meters, Their Theory and Application (6th Ed., 1971; Errata 1974)

4. Electronic Industries Association (EIA) Publications:

RS-232-C Interface Between Data Terminal Equipment and
Data\Communication Equipment Employing Serial Binary Data
Interchange (Oct. 1969)

5. The Institute of Electrical and Electronics Engineers, Inc. (IEEE) Publications:

No. 142-1991 Recommended Practice for Grounding of Industrial and
Commercial Power Systems
No. 1100-1992 Powering and Grounding Sensitive Electronic Equipment
No. 587-80 Guide for Surge Voltage in Low Voltage AC Power Circuits

6. National Electrical Manufacturers Association (NEMA) Publications:

250-1979 Enclosures for Electrical Equipment Incl. Rev. 1 (1000 Volts
Maximum)

7. Underwriters Laboratories (UL):

UL 1449-1987 Transient Voltage Surge Suppressors
UL 268A Smoke Detectors for Duct Applications

8. National Fire Protection Association (NFPA)

NFPA 70 National Electric Code
NFPA 101 Life Safety Code
NFPA 92A Recommended Practice for Smoke Control System

9. 2009 International Codes

2.4 SUBSTITUTIONS

- A. It is the Owner's intent to get all common types of equipment on this project. For instance, if the DDC System Supplier decides to use a Type A unitary controller of an AHU, the Owner does not want to see both Type A or Type B controllers installed on the project over the life on similar equipment of the project.
- B. The DDC System Supplier shall furnish the sensors which he submits in his technical proposal only.

- C. "Approved equal", as listed behind each supplier, means as approved by the Architect and Owner. When "approved equal" is listed, the DDC System Supplier shall provide the particular product specified or a comparable item with all the specified characteristics and accessories which is manufactured by a reputable manufacturer. No device, sensor, or equipment shall be substituted without the Owner's approval. Where the particular device does not meet the required specification, the DDC System Supplier will be required to provide an "approved" device at the same cost as listed on the bid form for all lump sum work.
- D. Should a sensor or equipment device become technically obsolete or unavailable or should a sensor or equipment device provide unsatisfactory service as judged by the Owner and/or the DDC System Supplier, a substitution may be made. Once the substitution is made, all of the devices installed thereafter shall be the "substitute" device.

2.5 SUBMITTALS - GENERAL

- A. The DDC System Supplier shall be prepared to submit requested data or samples on all material and equipment items to be installed on the project.
- B. General
 - 1. After award of contract, all items of computer software and technical data (including technical data which relates to computer software), which are specifically identified in the specification, shall be delivered strictly in accordance with the requirements of the specification to the Architect/Engineer. The Engineer and/or Architect will review all submittals and samples of conformance with design concept of the project and the information contained in the contract documents. The Engineer's and/or Architect's review is for the convenience of the Owner in following the work and does not relieve the vendor/supplier/manufacturer of the responsibility of deviations from the requirements stated in the specification and contract documents. The Engineer's and/or Architect's review shall not be construed as a complete or detailed check of the work submitted nor shall it relieve the vendor/supplier/manufacturer of responsibility for errors of any sort in the submittals and samples or from the necessity of furnishing any work required by the contract documents which may have been omitted from the submittals. The review of a separate item shall not indicate review of the complete assembly in which it functions. Nothing in the Engineer's and/or Architect's review of submittals and samples shall be considered as authorizing (1) a departure from contract documents or the specification, or (2) additional cost to the Owner, or (3) increased time for completion of the work.
 - 2. The Engineer and/or Architect will review submittals with reasonable promptness and will return them to the DDC System Suppliers. The proposals will be stamped as follows to indicate the appropriate action taken:
 - a. Reviewed.
 - b. Revise and resubmit.
 - c. Rejected.
 - 3. Manufacturer's data sheets for material and equipment shall include model numbers, dimension drawings, operating weights, material specifications, operation and controls, wiring diagrams, performance characteristics, and service procedures, including clearance requirements for maintenance work and conformation to specified codes.
 - 4. No part of the work shall be started in the shop or in the field until the Engineer and/or Architect has reviewed the shop drawings and samples for that respective portion of the work. Shop drawings and samples shall be submitted for review sufficiently in advance

of the scheduled start of the work in the shop or in the field to allow ample time in consideration of the number and complexity of the drawings in the submittal, for the Engineer and/or Architect to make an orderly review. No extension of time will be granted to the DDC System Supplier by reason of failure to perform in this respect.

5. Each shop drawing and sample submitted for review shall be accompanied by a letter of transmittal and shall be identified by the project title, DDC System Supplier's name, and a reference to the related point of the contract documents.
6. Shop drawings shall be 11 inch by 17 inch, landscape, bound on the left edge. Organize the packages by building if applicable.
7. All text based documents and product data sheets shall be 8 ½ inch by 11 inch format bound on the left edge.
8. All shop drawings in AutoCAD and PDF format shall be included on fully labeled CDs that includes a table of contents file in PDF format that provides a description of all of the files on the CD.
9. All submittal packages shall be submitted in a "D" clip binder of adequate size to comfortably fit all material enclosed.

C. Design Review Meeting.

1. The selected controls contractor is required to set up a meeting with the Architect / Engineer at their office to review the design intent and submittal requirements prior to the submission of the first submittal package.
2. The GC and Mechanical contractor shall also attend this meeting and record meeting minutes.

2.6 SUBMITTALS FOR PACKAGES

A. Group I Technical Data Package: The items listed in this paragraph should be provided prior to starting the installation of the DDC system:

1. System Drawings: The submittals shall include the following:
 - a. Operator's console equipment installation, block diagrams, and wiring diagrams.
 - b. DCP/DTC installation, block diagrams, and wiring diagrams.
 - c. DCP/DTC physical layout and schematics.
 - d. DCP/DTC/UCP physical layout and schedules.
 - e. Sensor and control wiring and installation drawings.
 - f. Details of connections to power sources, including grounding.
 - g. Details of surge protection device installations.
 - h. Instrumentation and control diagrams that are to be posted.
 - i. All the drawings shall also be supplied on a CD disc in AutoCadd format.
 - j. Schematics showing communication equipment such as a phone modem, etc.

2. Equipment Data: The submittals shall include complete catalog cut data for all materials to be installed including field and system equipment. The following equipment shall be submitted for prior approval in order to expedite subsequent project submittals.
 - a. Operator's equipment
 - b. DCP/DTC/UCP
 - c. Enclosures
 - d. Power supply
 - e. Relays
 - f. Terminal strips
 - g. Field devices.

3. System Description and Analyses: The submittal shall include system descriptions and analyses used in sizing equipment required by the specification. Descriptions shall describe how the equipment will operate as a system to meet the performance of the specification. This system description will not necessarily include proprietary information but must include sufficient information for a building control system operator to learn about the system operation; it may serve as a text for the training course. The submittals shall include, but not be limited to, the following:
 - a. Operator's console requirements.
 - 1) Communication speed and protocol description (if standard methodologies are used, refer to such standards). The DDC System Supplier, when selected will be required to provide their system protocols to the Owner under a non-disclosure agreement.
 - 2) DCP memory size.
 - 3) DCP automatic start up operations.
 - 4) Database update procedure.
 - 5) DCP expansion capability and method of implementation.
 - 6) Sample copies of each type of DCPs-generated report.
 - 7) Database entry forms.
 - 8) Historical data and trending methodology.

 - b. Software Data: The submittals shall consist of complete descriptions of DCP and operator's console software as specified. The software data will not necessarily include proprietary information but must include sufficient information for a building control system operator to learn how to operate the DDC system; it may serve as a text for the training course. The submittals shall be organized as follows:
 - 1) DCP Functions
 - 2) DCP Operating System
 - 3) DCP Start-up
 - 4) DCP Operations
 - 5) DCP Applications Software
 - 6) DCP Communications Software
 - 7) DCP Commands
 - 8) Operator's Console Operating System
 - 9) Operator's Console Communications Software
 - 10) DE Definition Process
 - 11) Reports
 - 12) Control Sequences for all DCPs, DTCs, and UCPs.

- c. Certifications:
 - 1) FCC Certifications: All specified FCC certifications shall be provided with the first submittals.
- 4. Specific Shop Drawing Requirements
 - a. System Architecture Design Diagram
 - 1) This is a riser diagram that shall show the IP layer and all of the field bus layers.
 - 2) It shall show each computer, printer, router, repeater, controller, and protocol translator that is connected to either the IP layer or any of the field busses.
 - 3) This diagram shall include the existing control system that is to be integrated into the common enterprise level system.
 - 4) Each component that is shown shall have a name that is representative of how it will be identified in the completed database and the manufacturer's name and model number.
 - 5) The physical relationship of one component to another component shall reflect the proposed installation. Example: If AHU1 controller is the closest controller to the Building Controller on the field bus, then this device shall be shown as the first device on the riser diagram just below the Building Controller.
 - b. This diagram shall not include power supplies, sensors or end devices.
 - 1) Layout Design Drawing for each control panel:
 - 2) The layout drawing shall be to scale with all devices shown in their proposed positions.
 - 3) All control devices shall be identified by name.
 - 4) All terminal strips and wire channels shall be shown.
 - 5) All control transformers shall be shown.
 - 6) All 120 VAC receptacles shall be shown.
 - 7) All IP connection points shall be shown.
 - c. Wiring Design Diagram for each control panel.
 - 1) The control voltage wiring diagram shall clearly designate devices powered by each control transformer. If the control devices use half wave power, the diagram shall clearly show the consistent grounding of the appropriate power connection. All wire identification numbers shall be annotated on the diagram.
 - 2) The Field Bus wiring diagram shall clearly show the use of the daisy chain wiring concept, the order in which the devices are connected to the Field

Bus, and the location of end of segment termination devices. All wire identification numbers shall be annotated on the diagram.

- 3) If shielded communication wiring is used, the grounding of the shield shall be shown.
 - 4) The terminal strip wiring diagram shall identify all connections on both sides of the terminal strip. Wiring label numbers for all wiring leaving the control panel shall be annotated on the diagram.
- d. Wiring Design Diagram for individual components (controllers, protocol translators, etc.): The wiring diagram for each component shall identify all I/O, power, and communication wiring and the locations on the terminal blocks to which the wires are landed. Example: Fan Status sensor is wired from terminals 5/6 on the controller to terminals 17 and 18 on the terminal strip.
- e. Installation Design Detail for each I/O device.
- 1) A drawing of the wiring details for each sensor and/or end device.
 - 2) For devices with multiple quantities, a standard detail may be submitted.
- f. A System Flow Design Diagram for each controlled system.
- 1) A two dimensional cross sectional diagram showing key components such as fans, coils, dampers, valves, pump, etc.
 - 2) Identify the locations and names of all sensors and end devices that are associated with the control system. Label the panel name and terminal numbers where the connections are landed.
 - 3) A legend shall be provided for all symbols used.
- g. Direct Digital Control System Hardware Technical Data.
- 1) A complete bill of materials of equipment to be used indicating quantity, manufacturer, and model number.
 - 2) Manufacturer's description and technical data for each unique device to include performance curves, product specification sheets, and installation instructions. When a manufacturer's data sheet refers to a series of devices rather than a specific model, the data specifically applicable to the project shall be highlighted or clearly indicated by other means.
 - 3) This requirement applies to:
 - a. Controllers
 - b. Transducers/Transmitters
 - c. Sensors
 - d. Actuators

- e. Valves
 - f. Relays and Switches
 - g. Control Panels
 - h. Power Supplies
 - i. Batteries
 - j. Operator Interface Equipment
- h. An Instrumentation List for each controlled system.
- 1) The list shall be in a table format.
 - 2) Include name, type of device, manufacturer, model number, and product data sheet number.
- i. Sequence of Control: A sequence of control for each system being controlled. Include the following as a minimum.
- 1) Process control sequence for each end device.
 - 2) Supervisory logic sequence of control for each system.
 - 3) The impact of each global application program on the sequence of control (Example: Demand Control).
 - 4) A list of all physical inputs and outputs associated with each sequence.
 - 5) Within the sequence of control, all application parameters that are to be user adjustable from an OWS shall be annotated with (adj) after the name of the parameter. This shall include set points, reset schedule parameters, calibration offsets, timer settings, control loop parameters such as gain, integral time constant, sample rates, differentials, etc.
 - 6) Within the sequence of control, all calculated values that are to be viewable at the OWS shall be annotated with (rpt) after the name.
 - 7) All points that shall be subject to manual control from an operator workstation.
 - 8) A list of all alarm points, a description of the alarm and a description of the alarm criteria.
 - 9) A list of all variables for which historical trending will be applied, the sample rates and any criteria used to start and stop the historical trending.
- j. Binding Map
- 1) A list of the device to device data flow. This shall not include the flow of data from devices to the presentation system.
 - 2) Include:

- a. Description of the variable.
- b. Sending device.
- c. Receiving device.

- k. Graphic Pages: Submit a sample graphic page for each type of page described in the specification section on graphic pages

- l. Setpoint List
 - 1) Provide a list of all setpoints for the project by sequence number
 - 2) The list shall indicate the value of all setpoints that were gleaned from the contract documents.
 - 3) All setpoints that will be field adjusted during the commissioning and balancing processes shall be noted.
 - 4) All setpoints that require additional information from the Architect / Engineer shall be noted.

- m. Graphical Sequence Diagrams:
 - 1) Provide a graphical sequence diagram for every sequence
 - 2) This diagram shall match the programming used for the sequence. One should be able to determine exactly how the sequence was programmed and all of the logic contained in the sequence. All nodes shall be labeled for clarity.
 - 3) This diagram will be used by the College to trouble shoot issues with the system after the building has been turned over to the owner. The diagram shall be modified at the end of the project to match the as built conditions.
 - 4) If the selected control vender uses a graphical program langue, those diagrams may be used as long as they are clear and well labeled.

- n. Object, Device, and Network naming convention:
 - 1) The college has a standing naming convention for all control objects, devices, and networks. The controls contractor shall use these naming conventions when they prepare the control submittal.
 - 2) The naming convention standard will be made available to the controls contractor for their use.

B. Group II Technical Data Package:

- 1. Operation Verification Testing and Endurance Testing Data: A Test Plan and Test Procedures for the Operation Verification Test and Endurance Test shall be delivered to the Architect/Engineer for approval. The Owner reserves the right to witness any and all testing and shall be notified in advance of testing. The Test Plan shall describe in general

terms the applicable tests to be performed, other pertinent information such as specialized test equipment required, and duration of Operation Verification Test. The test procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements of the specification. The "Test Plans" for the Operation Verification Test and Endurance Test shall be delivered to the Architect/Engineer. After receipt of written approval of the Test Plan, deliver the Operation Verification Test Procedures for approval. Written approval by the Architect/Engineer of the Operation Verification Test Procedures shall be one of the prerequisites for commencing the Operation Verification Test as specified. All the test and calibration equipment required for the Operation Verification Test shall be provided by the Contractor. The test equipment provided as part of the Central System package will be used for testing.

2. Operation and Maintenance Manuals: Copies of the draft operation and maintenance manuals, as specified for the Group III Technical Data Package, shall be delivered to the Architect/Engineer prior to beginning the Operation Verification Test for use during site testing.
3. Training Documentation: Lesson plans and training manuals for the training phases, including the type of training to be provided, with a list of reference material shall be delivered for approval.
4. Data Entry Forms: Deliver the completed data entry forms utilizing all data from the contract documents, field surveys, and all other pertinent information required for complete installation of the data base. Identify, and request from the Architect/Engineer any additional data needed to provide a complete and operational DDC system. The completed forms shall be delivered to the Architect/Engineer for review and approval at least 90 days prior to the DDC system's scheduled need date.

C. Group III Technical Data Package: The Group III Technical Data Package consists of the operation and maintenance manuals. Final copies of the manuals bound in hardback, loose-leaf binders shall be delivered to the Architect/Engineer within thirty (30) days after completing the Endurance Test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of manuals. Each manual's contents shall be identified on the cover. The manuals shall include the names, addresses, and telephone numbers of service representatives and of each subcontractor installing equipment and systems, and of the nearest service representatives for each item of equipment and each system. The manuals shall have a table of contents and tab sheets. The tabs on the tab sheets should be either laminated plastic or of metal construction to ensure that they do not disintegrate after repeated use. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the Endurance Test shall include all modifications made during installation, checkout, and acceptance. Manuals provided shall include:

1. Functional Design Manual: Twelve (6) copies.
2. Hardware Manual: Twelve (6) copies.
3. Software Manual: Twelve (6) copies.
4. Maintenance and Calibration Manual: Twelve (6) copies.
5. Operator's Manual: Twelve (6) copies.
 - a. Functional Design Manual: The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, specific functions and sequence of operations. A description of hardware and software functions, interfaces, and requirements shall be provided for all system operating modes.

- b. Hardware Manual: A manual describing computers, I/O equipment and sensors shall be provided, including:
- 1) General description and specification.
 - 2) Installation and checkout procedures.
 - 3) Equipment electrical schematics and layout drawings. (Field and panel wiring/piping diagrams between DCP panels and sensors and between DCP panels and control devices; it does not require schematics of DCP panel internal circuit boards.)
 - 4) System/network overview schematic drawings and I-O wiring lists.
 - 5) Alignment and calibration procedures.
 - 6) Manufacturer's repair parts list complete with part numbers, indicating sources of supply.
- c. Software Manual: The manual shall be arranged to provide for separate sections for operator's console software including:
- 1) Definitions of terms and functions.
 - 2) Directory of all disk files.
 - 3) Description of all communications protocols, including data formats, command characters, and a sample of each type of data transfer. The successful DDC System Supplier shall be required to provide the protocols to the Owner under a non-disclosure agreement.
 - 4) Operator Commands.
 - 5) System access requirements.
 - 6) Data entry requirements.
 - 7) Flow charts and source code listing for custom application programs developed for Owner.
 - 8) Provide a mathematical description of the control algorithms.
 - 9) Organize the manual to have separate sections for all DCP software, including: definitions of terms and functions; descriptions of algorithms for the applications programs; description of implementation of the applications programs; and description of data base structure and interface with running programs.
 - 10) Description of all communications protocols, including data formats, command characters, and a sample of each type of data transfer.
- d. Operator's Manual: The operator's manual shall provide all procedures and instructions for operation of the system, including:
- 1) Computers and peripherals.
 - 2) System start-up and shutdown procedures.
 - 3) Use of operating system, command, and applications software.
 - 4) Recovery and restart procedures.
 - 5) Detailed data collection procedures.
 - 6) Reports.
- e. Maintenance and Calibration Manual: The maintenance and calibration manual shall include descriptions of maintenance and, where applicable, calibration for each type of equipment or device including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components. In addition, the maintenance manual shall include the following:

- 1) Manufacturer's equipment parts list of all functional components of the system, control diagrams, and wiring diagrams.
- 2) "As-Built" interconnection wiring diagrams, or wire lists of the complete field installed system with the complete, properly identified ordering number of each system component and device.
- 3) Addresses and telephone numbers of suppliers of parts.
- 4) Emergency contact person(s) available for telephone consultation and field visit if needed.

D. Group IV Data Package

1. The DDC System Supplier shall supply all drawings, including drawing revisions after start-up, to the Owner on a CD disk in a format such as AutoCADD. These drawings shall include all manually produced drawings required in the Group I submittal.
2. Software
 - a. Submit a copy of all software installed on the servers and workstations.
 - b. Submit all licensing information for all software installed on the servers and workstations.
 - c. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.
 - d. Submit all licensing information for all of the software used to execute the project.
 - e. All software revisions shall be as installed at the time of the system acceptance.
3. Firmware Files
 - a. Submit a copy of all firmware files that were downloaded to or pre-installed on any devices installed as part of this project.
 - b. This does not apply to firmware that is permanently burned on a chip at the factory and can only be replaced by replacing the chip.
 - c. Submit a copy of all application files that were created during the execution of the project.
 - d. Submit a copy of all graphic page files created during the execution of the project.
 - e. Submit a copy of all secondary graphic files such as bitmaps, jpegs, etc. that were used in the creation of the graphic pages.

2.7 CHECK-OUT PROCEDURE

- A. Check-out shall be accomplished by the DDC System Supplier prior to start-up and testing with each individual package. The DDC System Supplier will be responsible to initiate the checkout procedure. The Owner shall be notified prior and, at their option, shall be present to witness.

- B. Two tests will be performed: A cold test and a hot test.
 - 1. Cold Test: In this test, the DDC System Supplier shall verify all wiring terminations prior to energizing any equipment.
 - 2. Hot Test: In this test, each control device, the DCP, DPT, and/or UCP shall be energized. Each sensor or transmitter shall be verified to be operating and connected to the proper termination address and each control device shall be operated.
- C. The DDC System Supplier shall jointly conduct the "cold" and "hot" tests. This will be demonstrated through a "Sensor/Operator Check-Off Procedure". The completed "check-off sheet" shall be turned over to the Architect/Engineer or Construction Manager as applicable prior to start-up and testing.
- D. The responsible DDC System Supplier shall repair any software problems, shorts, ground faults, leaks, wiring terminations, or tubing terminations as required, and shall repair or replace any defective parts.
- E. This check-out procedure shall be performed on all present and future packages.

2.8 START-UP AND TESTING

- A. The DDC System Supplier shall provide start-up, testing, and adjustment of the completed DDC System. The DDC System Supplier shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all start-up and testing. Written notification of any planned start-up and testing shall be given to the Architect/Engineer and Owner at least 14 days in advance of such work, and in no case shall notice be given until after written approval of the test plans and procedures as specified has been received from the Architect/Engineer.
- B. Startup Testing Plan: Submit a start up testing plan for each unique system.
 - 1. The purpose of a startup test is to demonstrate the "completeness" of the physical tasks associated with installation and the physical performance of the components.
 - 2. For each task on the startup test checklist, the plan shall require the technician to enter his or her initials and the date the test was completed along with any recorded data such as voltages, offsets, or tuning parameters. Any deviations from the submitted installation plan shall also be recorded.
 - 3. Required elements of the startup testing include:
 - a. Measurement of voltage sources, primary and secondary.
 - b. Verification of proper controller power wiring.
 - c. Verification of component inventory when compared to the submittals.
 - d. Verification of labeling on components and wiring.
 - e. Verification of connection integrity and quality (loose strands and tight connections).
 - f. Verification of bus topology, grounding of shields and installation of termination devices.
 - g. Verification of point checkout.

- 1) Each I/O device is landed per the submittals and functions per the sequence of control.
 - 2) Analog sensors are properly scaled and a value is reported
 - 3) Binary sensors have the correct normal position and the state is correctly reported.
 - 4) Analog outputs have the correct normal position and move full stroke when so commanded.
 - 5) Binary outputs have the correct normal state and respond appropriately to energize/de-energize commands.
- h. Documentation of analog sensor calibration (measured value, reported value and calculated offset).
 - i. Documentation of Loop tuning (sample rate, gain and integral time constant).
4. Submit at least four weeks prior to any scheduled start-up tests.
- C. The DDC System shall be started in stages to facilitate the construction schedule. The portions tested shall be as large as practically possible. Portions of the systems to be tested shall be started, operated, and tested independently of previously accepted portions of the system (i.e., before Local Project Specific LAN communication connections are made to the Main Facility-Wide LAN which may exist and be in operation at the time). Testing provided by the DDC System Supplier shall be designed to minimize interference between new and operating systems prior to making the actual LAN connection. The tests on new or add-on systems should include simulations of shared data or functions from the existing LAN system operation.
- D. Upon completion of the installation, the DDC System Supplier shall start up the system and perform all necessary testing and debugging operations. An acceptance test shall be performed in the presence of the Owner's representative and the Architect/Engineer. The acceptance test will be performed by the Owner's TAB Agency and/or commissioning agent and will cover sequence verification, sensor calibration, and point to point graphic verification. The University Building Engineer shall also be requested to be present to witness the start-up and testing. This test, as a minimum, shall include an operation/verification endurance test which verifies two weeks of completely automatic and stable system operation has occurred without an unexplained point failure or alarm. The system shall also provide comfort conditions in all spaces affected by the work.
- E. Startup Testing Report.
1. Startup testing reports shall be submitted on a per system basis.
 2. Startup testing reports shall be the documented results of the executed startup testing plans.
- F. Performance Verification Testing Plan: Submit a verification plan for each system.
1. The purpose of a performance verification test is to ensure that the system performs in accordance with the sequence of control. For each end device that is controlled, there shall be a series of step by step cause and effect tests to verify each aspect of the

sequence of control. A sample sequence of control with corresponding performance verification test is included as Appendix B.

2. A performance verification test shall also be defined for the operator interaction with the system. Test elements shall be written to require the verification of all operator interaction tasks including but not limited to the following.
 - a. Login and user settings.
 - b. Graphics navigation.
 - c. Trend data collection and presentation.
 - d. Alarm handling, acknowledgement, and routing.
 - e. Time schedule editing.
 - f. Application parameter adjustment.
 - g. Manual control.
 - h. Report execution.
 - i. Automatic backups.
 - j. Web Client access.
3. Submit at least 4 weeks prior to the scheduled execution of the test.

G. Upon receipt of a detailed punch list from the Architect/Engineer, an installation inspection report shall be prepared by the DDC System Supplier showing, by system, each outstanding item on the punch list. After all items appearing on the installation inspection report are completed, a second written request for system approval shall be made to the Architect/Engineer. As each or all items are approved, an appropriate notation shall be entered at the time of joint inspection on the system report, with countersignature of the Architect/Engineer and date. A copy of this report shall be made for the Owner.

H. Where it is required for the DDC System Supplier to modify, alter, add or remove hardware or software programs to the system, or related accessories for the purpose of eliminating punch list items, off-line operation and testing to implement these items shall be performed as required until such time acceptable performance of the system has been established at no additional cost to the Contract.

I. Problems which occur within approved hardware, or software, shall be corrected in an appropriate fashion under warranty. Any such occurrence shall not void previous approval; however, the DDC System Supplier shall be responsible to attend to and remedy such items within the warranty period. The DDC System Supplier shall maintain appropriate logs, schedules, and reports to reflect these items and their redress.

2.9 TRAINING FOR OWNER'S PERSONNEL

A. General: Conduct training courses for designated personnel in the maintenance and operation of the DDC system as specified. The training shall be oriented to the specific system being installed under this contract. Training manuals shall be provided for each trainee with three (3)

additional copies provided for archival at the project site. The manuals shall include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. The room for training will be provided by the Owner. The audio/visual equipment will be provided by this Contractor. The DDC System Supplier shall communicate his requirements for this equipment to the Owner five (5) working days before the date when the equipment is needed. The DDC System Supplier shall be responsible for all other training material and supplies. Where portions of the course material are presented by audio/visuals, copies of those audio/visuals shall be delivered to the Architect/Engineer either as a part of the printed training manuals or on the same media as that used during the training sessions, in the same quantity as specified for training manuals. A training day is defined as eight (8) hours of classroom instruction, including two 15-minute breaks and excluding lunchtime, Monday through Friday, during the normal first shift in effect at the training facility. For guidance in planning the required instruction, assume that attendees will have a high school education or equivalent, and are familiar with HVAC systems. Notification of any planned training shall be given to the Architect/Engineer at least thirty (30) days prior to the training. If off-site training is required, the Owner will take care of travel and lodging arrangements. The Owner may videotape all training sessions.

- B. Operator's Training I: The first course shall be taught at the project site for a period of six (6) consecutive training weekdays during the field testing activity. The Contractor shall assume that a minimum of two (2) training sessions with five (5) people in each will be required. Upon completion of this course, each student, using appropriate documentation, should be able to perform elementary operations with guidance and describe the general hardware architecture and functionality of the system. This course shall include:
1. General system architecture.
 2. Functional operation of the system.
 3. Operator commands.
 4. Control sequence programming.
 5. Data base entry.
 6. Reports and logs.
 7. Diagnostics.
- C. Operator's Training II: The second course shall be taught while the Endurance Test is in progress for a total of sixteen (16) hours of instruction per student, in time blocks of four (4) hours. The DDC System Supplier shall assume that six training sessions with two (2) people in each will be required. The schedule of instruction shall allow for each student to receive individual instruction for a four-hour period in the morning (or afternoon) of the same weekday for two (2) consecutive weeks. The Contractor shall schedule his activities during this period so that the specified amount of time will be available during the Endurance Test for instructing the students. The course shall consist of "hands-on" training under the constant monitoring of the instructor. The instructor shall be responsible for advising the Owner about the appropriate password to be issued to the student commensurate with each student's acquired skills at the beginning of each of these individual training sessions. Upon completion of this course, the students should be fully proficient in the operation of all system operations. The training instructor shall prepare a written report describing the skill level of each student at the end of this course and supply three (3) copies to the Architect/Engineer within seven (7) days of completion of the training.
- D. Maintenance Personnel Training: The maintenance course shall be taught at the project site after completion of the Endurance Test for a period of six (6) training days. The Contractor shall assume that three (3) training sessions of eight (8) people will be required. The training shall include:
1. Physical layout of each piece of hardware.

2. Troubleshooting and diagnostics procedures.
3. Repair instructions.
4. Preventive maintenance procedures and schedules.
5. Calibration procedures.

E. Executive Training for Planners/Supervisors: This training course shall be taught after completion of the Performance Testing. The requirements of this training course are to provide necessary background to the engineering planners/supervisors about the operation of the DDC system. This training shall consist of two 4-hour classes. Before commencement of this training, at least fourteen (14) days advance notice should be given to the Architect/Engineer. The Owner will stipulate the number of people that will attend this training course. The training shall include, but not be limited to, the following:

1. Brief description of system architecture.
2. Functional operation of the system.
3. Summary of operator commands.
4. Overview of control sequence programming.
5. Organization of the database.
6. Reports and logs that are available.
7. Overview of the system diagnostics capabilities.
8. Transport of summary level data about building operation energy use and maintenance, for use with commercial spreadsheets and word processing programs.
9. Training for the remote monitoring of the DDC system.
10. Description of the database for detailed (every minute) data collection and method for access.

F. Training/Review Session: Conduct one 8-hour training or review session at the project site, no less than thirty (30) days and no more than sixty (60) days after the acceptance test. The purpose of this session is to allow the trainees to have their questions, which they may have had after system operation, answered. Further training/review sessions may be obtained by the Owner based on unit prices listed in the bid documents.

2.10 TRAINING FOR "ADD-ON"

- A. The DDC System Supplier shall provide instructions for all new add-on systems or packages as they come on-line. Each instruction session shall include one 8-hour classroom period. For guidance in planning, it is assumed that all of the students attending these classes are familiar with the existing DDC System and its capabilities and/or have attended previous training classes.
- B. The purpose of the instruction is to familiarize the building operators with the new equipment being installed under this contract.
- C. The DDC System Supplier shall provide a minimum of ten (10) manuals for instruction in addition to the material required for the trainees. The Owner has stipulated that the maximum number of personnel who will attend each session is six (6). The instruction session will be scheduled with the Owner. The notice for starting the training shall be given to the Architect/Engineer. This notice shall not be less than fourteen (14) days in advance of training.
- D. The 8-hour classroom training period will include the following:
 1. General description of new equipment installed.
 2. A listing and description of each new point and its "name".

3. A general description of the sequence of operation for each new piece of equipment including normal setpoints and all normal and emergency functions. This should include a review of appropriate control drawings, etc.
4. Maintenance training for all "new types" of equipment installed in the facility as a part of the contract.

2.11 WARRANTY TO BE PROVIDED AS PART OF EVERY PACKAGE

- A. All devices and components shall be warranted for a period of two (2) years following the date of acceptance of the Performance Verification Test. All system management consoles, DCP, UCPS and software shall be warranted and upgraded to the latest operating system version for a period of five (5) years following the date of acceptance of the Performance Verification Test. This warranty shall include labor and material. Any defects arising during this warranty period shall be corrected without cost to the Owner. During the warranty period, the Contractor's service personnel shall be available to be physically present at the facility within twenty-four (24) hours for emergency repairs. The Contractor shall consider the possibility of allowing Owner's trained maintenance personnel to affect repairs of extremely critical nature, even before the service representative arrives at the site. For this purpose, a stock of necessary spare parts shall be maintained at the facility. If the Owner's stock of spare parts is used for in-warranty repair, such stock shall be replenished within ten (10) working days.
- B. Programmed Preventive Maintenance. The DDC system supplier will perform programmed preventive maintenance. For this purpose, complete requirements for this activity shall be provided, prior to final payment.
- C. Preventive Maintenance. The DDC system supplier will perform all required programmed preventative maintenance. Provide complete instructions and the requirements for this activity. Also provide a schedule list for this activity. Each schedule shall list the equipment name, location, and appropriate preventive maintenance functions to be performed during that inspection. The work performed includes, but is not limited to, the following:
 1. Check calibration, recalibrate if needed, instrumentation sensors for air flow, liquid flow, pressure, humidity, temperature, and transmitters. Written records shall be kept indicating the performance of such calibrations along with pertinent data. The calibration and operational ranges for all sensors shall be kept with the written records.
 2. Check the operation of dampers and damper actuators to assure no seizing or lock-up has occurred. Written records shall be kept indicating the performance of such calibrations along with pertinent data.
 3. Check the overall system field operation by performing an all-points review (by hard copy or by documenting all point CRT inquiries). Verifying that all monitoring and command points are valid and active.
 4. Check alarming capabilities and system response by initiating alarms and observing the time duration of the responses. Written records shall be kept indicating the performance of such exercises.
- D. Upgrades and Maintenance: standard software upgrades shall be included in the price for a period of five (5) years. Training required for software within this period shall be free of charge. Upgrades after this would be at additional cost and at the Owner's discretion. If software is changed due to error (or bugs), such modifications to the software shall be at no cost to the Owner for a period of ten (10) years.
- E. Failure by the DDC System Supplier to provide warranty work within one (1) day shall render his conduct as negligent, in which case the Owner shall be entitled to proceed with such work at his

discretion and back charge the DDC System Supplier at cost plus 10 percent for expenses incurred.

- F. The DDC system supplier shall maintain for the Owner a complete accounting of all systems and components that are under warranty, including a listing of all systems under extended warranty. The listings shall be submitted to the Owner on a quarterly basis.
- G. During the first two years of operation, make any recommendations for system modification, in writing, to the Owner and Architect/Engineer. No system modifications, including operating parameters and control settings, shall be made without prior approval of the Architect/Engineer. Any modifications made to the system shall be incorporated into the operation and maintenance manuals, as-built drawings, and other documentation affected.
- H. The DDC System Supplier shall provide all custom software updates for control sequence modifications and verify operation in the system. These updates shall be accomplished in a timely manner, shall be fully coordinated with DDC System operators, and shall be incorporated into the operation and maintenance manuals, and software documentation.

2.12 THREE (3) YEAR EXTENDED MAINTENANCE PROGRAM

- A. The DDC System Supplier shall provide guaranteed prices for service contract to maintain the system as described above. This price shall be applicable for three (3) years after the warranty expires, and not during the warranty period. Prices shall be submitted for service contractor on a per year basis for the three (3) years. The acceptance of the service contract shall be at the sole discretion of the Owner.
- B. This work shall include all parts and services required and equipment necessary to maintain the entire DDC System in an operational state as specified and shall be provided for a period of three years after the initial warranties expire. Impacts on facility operations shall be minimized when performing scheduled adjustments or other nonscheduled work.
- C. The adjustment and repair of the DDC System includes all computer equipment, software updates, transmission equipment, DCP's, and all new sensors and control devices. Responsibility shall include all equipment furnished as a part of the DDC system. The manufacturer's required adjustments and all other work necessary shall be provided.
- D. A minimum of two service personnel shall be qualified to accomplish all work promptly and satisfactorily with the DDC System Supplier's service organization. The Owner shall be advised in writing of the name of the designated service representative, and of any changes in personnel. In addition, when a change in personnel is made, the outgoing or remaining representative is expected to orient the "new" service representative to the system and to the building. The DDC System Supplier's service personnel are expected to be familiar with the facility, with the location of the DDC System Devices, and with the locations of the equipment served by these devices without being accompanied by the Owner's personnel.
- E. The work shall include two minor inspections at six-month intervals or less, two major inspections (offset equally between the minor inspections to effect quarterly inspection of alternating magnitude), and all work required as specified. Preferably, major inspections shall be scheduled in June and December.
 - 1. Minor inspections shall include:
 - a. Visual checks and operational tests of all equipment.

- b. Check the overall system field operation by performing an all-points review (by hard copy or by documenting all point CRT inquiries). Verify that all monitoring and command points are valid and active.
 - c. Inventory and replenish the Owner's stock of spare parts that the contractor has used in maintenance and repair of the system.
 - d. Submit report to the Owner detailing exact items or tasks which were accomplished.
 2. Major inspections shall include all work described under "Minor Inspections", plus the following work:
 - a. Perform diagnostics on all equipment.
 - b. Resolve any previous outstanding problems.
 - c. Submit report to the Owner detailing exact items or tasks which were accomplished.
- F. In addition to periodic inspections, the DDC System Supplier shall perform in accordance with a program of standardized preventative maintenance as applicable to the Owner's equipment. Maintenance shall be performed a minimum of four times per year and shall coincide with the major and minor inspections. During this activity, the DDC equipment functions shall continue. Each schedule shall list the equipment name, location, and appropriate preventive maintenance functions to be performed during that inspection. The work performed shall include, but not be limited to, the following:
 1. Clean all system equipment including CPU, disk memory, RGB color CRT, monochrome CRT, printer, intercom, DCP units, and printed circuit boards.
- G. All minor and major inspections and all preventative maintenance work shall be performed during regular working hours, Monday through Friday, excluding legal holidays and as agreed to by the Owner.
- H. Performance of scheduled adjustments and repair shall verify operation of the DDC System as demonstrated by the applicable portions of the Operation Verification Test.
- I. Refer to Warranty paragraph for requirements on emergency service.
- J. The DDC System Supplier shall keep records and logs of each task, and shall organize cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain all initial analog span and zero calibration values and all digital points. Complete logs shall be available for inspection on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the DDC System.
- K. Each maintenance service call request shall be recorded by the DDC System Supplier, as received. The record shall include the serial number identifying the component involved; its location, date, and time the call was received; nature of trouble; names of the service personnel assigned to the task; instructions describing what has to be done; the amount and nature of the materials to be used; the time and date work started; and the time and date of completion. The Owner shall receive a record of the work performed within five (5) days after work is accomplished.
- L. The DDC System Supplier shall make available at no additional cost standard software upgrades which will make available corrections and improvements in software which the Owner has already purchased as a part of this contract. This shall be done for the first five (5) years of

the warranty. If the Owner chooses to have a service and maintenance contract, then the DDC System Supplier shall provide and install all software upgrades at no cost, as long as the service and maintenance contract remains in effect.

- M. The DDC System Supplier shall provide all replacement hardware for three years after the warranty expires. Replacement hardware shall be purchased at the agreed upon prices given in the bid form.
- N. Failure by the DDC System Supplier to provide (start and complete) scheduled maintenance work within 30 days of the established service schedule dates shall render his conduct as neglect, in which case the Owner shall be entitled to proceed with such work at his discretion and back charge the DDC System Supplier at a cost plus 10 percent for expenses incurred. Expenses shall include both material and labor.

2.13 SPARE PARTS

- A. The DDC System Supplier shall provide, if directed by the Owner, spare parts. The DDC system supplier will be compensated in accordance with the price identified on the Bid Form, Document 00400. These spare parts are to be used for emergency service work and for preventative maintenance work and shall be restocked within ten (10) days of use. The entire stock of parts shall be provided when the first equipment is started up and shall be available intact at the end of the warranty period.

- 1. Provide a recommended spare parts list to the Owner for review.

2.14 INSTALLATION FOR ALL PACKAGES

- A. Installation of Equipment

- 1. This paragraph describes requirements for installation of equipment on this project.
- 2. All system components and appurtenances shall be installed in accordance with the component manufacturer's and the DDC System Supplier's instructions. All necessary interconnections, services, and adjustments required for a complete and operable system shall be provided. All electrical work and devices shall comply with the National Electric Code and the requirements of the City of Rockville, Maryland and all other applicable codes, and shall be installed by licensed journeyman electricians. Instrumentation and communications grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.
- 3. All equipment shall be installed as required for an operational DDC system. In addition, the following additional precautions shall be followed and equipment shall be provided as required:
 - a. All room thermostats and humidistats shall be mounted 48"-54" above the finished floor except in corridors, stairways and toilet rooms where they shall be mounted at 7'-0" above the finished floor. Refer to drawings for exemptions.
 - b. RTD assemblies shall be readily accessible and installed in a manner to allow easy replacement.
 - c. All RTDs installed in liquids shall be installed in stainless steel thermowalls.
 - d. RTDs used for space temperature sensing shall include housing suitable for wall mounting. The housing shall also shield the sensor from sources of radiation.
 - e. RTDs used for OA sensing shall have an aspirated radiation shield. The installation of OA sensors shall not be within the thermal boundary layer of the

- building, away from all building and automobile exhausts and shall not be mounted on concrete surfaces or on the roof.
- f. OA temperature and humidity transmitter shall be provided for, as indicated on the drawings. The preferred location is on the northward facing side of a building or on a louver mullion to an air handling unit which is scheduled to operate continuously.
 - g. Averaging sensors in mixed air plenums should be installed across possible stratified air paths to insure a true average temperature.
 - h. Pipe temperature sensors shall be located at least ten (10) pipe diameters downstream of converging (mixing) pipe flows.
 - i. Temperature switches shall be installed in a manner similar to RTDs. Temperature switches shall be adjusted to the proper setpoint and shall be verified by calibration.
 - j. Relative humidity sensors shall have air guards when in-stalled in air flows of more than 50 feet per minute across the sensor element.
 - k. Pressure sensors (all types) installed on liquid lines shall have drains. Pressure sensors installed on steam lines shall have drains and siphons or drains and condensate chambers. All pressure sensors shall have 3-way valve manifolds for isolation, venting, by-passing and taps for calibration. Pressure sensors shall be verified by calibration. Differential pressure sensors shall have nulling valves.
 - l. Pressure switches and differential pressure switches shall be adjusted to the proper setpoint, and shall be verified by calibration. Pressure switches shall be mounted higher than the process connection.
 - m. All flowmeters shall be installed in accordance with ASME "Fluid Meters, Their Theory and Application" and other applicable industry standards. Do not install obstructions, such as temperature wells, in flowmeter "flow tubes".
 - n. Flow switches shall be installed in such a manner as to minimize any disturbance in the flow of fluid while maintaining reliable operation of the switch.
 - o. Potential and current transformers shall be installed in approved electrical enclosures.
 - p. Watthour and demand meters shall be installed in approved electrical enclosures, in motor starter enclosures or in electrical switchgear enclosures.
 - q. Position sensing potentiometers shall be selected and in- stalled with type and mounting suited for the application to provide reliable operation.
 - r. End (Limit) Switches shall be selected and installed with type and mounting suited for the application to provide reliable switch operation.
 - s. Relays and contactors shall be installed in approved electrical enclosures, apparatus control panels, DCP panels, DTC panels, or in starter enclosures.
 - t. Electric solenoid operated pneumatic (EP) valves shall be installed in approved electrical enclosures or in apparatus control panels.
 - u. Pneumatic receiver/controllers shall be installed in apparatus control panels.
 - v. Current to pneumatic (I/P) transducers shall be installed in apparatus control panels, DCP panels or in DTC panels.
 - w. All temperature, humidity, and flow sensing transmitters and switches located in ductwork shall be installed in locations where the devices can be easily removed for routine maintenance and cleaning. This is particularly important for devices located in return air, exhaust air, and unfiltered air ductwork.
 - x. All wind speed and wind direction sensing devices shall be installed in a location as directed by the Architect.
4. All apparatus control panels, DCP panels and DTC panels shall be installed with the bottom 4 feet above the adjacent floor surface using an adjacent wall surface or using legs for free standing applications. All free-standing outdoor enclosures using legs shall be secured rigidly to the supporting surface to minimize vibrations from winds.

5. All penetrations in apparatus control panels and DTC panels located outdoors shall be from the bottom and shall be sealed to preclude entry of water using a silicone rubber sealant.
6. The electrical portion of the DDC system shall be installed according to the following provisions:
 - a. Designated circuit breakers shall be provided in various electrical distribution panel boards for powering the DDC system.
 - b. The DDC System Installer shall provide all power wiring required for the various apparatus control panels and DDC panels (UCPs) and sensors from these circuit breakers.
 - c. The DDC System Installer shall provide supplemental branch circuitry and short circuit protection including panel boards as required for proper power distribution, protection and operation of his system and equipment.
 - d. All wiring, conduits, additionally panel boards, etc., required to provide power for the individual DDC equipment items shall comply with the National Electrical Code (NEC), the requirements of the City of Rockville, Maryland, and other applicable codes.
 - e. All other electrical wiring shall comply with the National Electric Code, the requirements of the City of Rockville, MD, and other applicable requirements and shall be installed by licensed journeyman electricians.
 - f. All peer-to-peer connections to the DDC system and the peer-to-peer network wiring and conduit shall be installed in locations identified by the DDC System Supplier in conjunction with the Architect/Engineer.
 - g. All DCPs, DTCs, and UCs, for the steam meters, shall be powered by normal/emergency power circuits.
 - h. All wiring shall be properly color-coded or identified (using terminal numbers) or both at the termination point in the DCP and DTC panels so that wiring between the panel and the sensing/control device can be easily identified.
7. All control wire and power wiring shall be provided by the DDC System Supplier. All wiring shall be installed in watertight EMT conduit with compression fittings. All copper and fiber network wiring shall be installed in watertight EMT conduit.
 - a. AI, BI, AO and low voltage BO wires shall be routed uniformly in a singular bundle or through a single conduit.
 - b. Singular or multiple 120 volt BO wires shall be routed uniformly in a singular bundle or through a single conduit. High voltage (120 volt) BO wiring shall not be installed in the same bundle or conduit as AI, BI, or AO wiring unless otherwise specified.
 - c. Network wiring in exposed areas shall be installed in a conduit with no other wiring.
 - d. All conduit shall be EMT to within 3 feet of the device. Within 3 feet, flexible conduit may be employed. All conduit shall be supported from the building structure and should not lay on the ceiling.
 - e. All wiring and conduit shall be run either parallel or perpendicular to walls constructed in the area served. All takeoffs or junctions shall be made at 90 degree angles.
 - f. Pull strings shall be provided in all conduits for the future addition of wires.
 - g. Provide wire identification tags (using terminal numbers) in all DCP's and DTC's panels designating terminal connection points so that wiring between the panel and the sensing/control device can be easily identified. Tab 2 shows the Owner's approved scheme for panel and equipment identification.
 - h. All wiring in mechanical rooms shall be in conduit.

- i. Low voltage and analog wiring shall be a minimum of 18 gauge twisted shielded pair.
 - j. 120 volt wiring shall be a minimum of 16 gauge twisted pair for relays or status wiring.
 - k. Communication wiring shall be a minimum of 22 gauge twisted low capacity.
8. The requirements concerning wire and conduit installation may also be found elsewhere in the specification and drawings.
9. All instrument air lines shall be run concealed in the building construction in all finished spaces. Air lines exposed in unfinished spaces shall be run in a neat and workmanlike manner in metal raceways or conduit, or shall run exposed in hard copper tubing. Provide shut-off valve for branch isolation. All pneumatic tube material shall be suitable and approved for the service in the city of Rockville, Maryland.
 - a. All concealed accessible instrument air lines shall be run in approved polyethylene tubing. All tubing shall conform to the requirements of the city of Rockville, Maryland.
 - b. All concealed inaccessible tubing shall be run in hard or soft copper tubing or in conduit.
 - c. Where required, all conduit shall be rigid electromechanical tubing to within 3 feet of the device. All conduits shall be supported from the building structure and should not lie on the ceiling.
 - d. All pneumatic tubing run without conduit shall run in bundles which are attached together using nylon ties at 3-foot intervals. Home runs of individual pneumatic tubes when bundled are available is unacceptable. All individual and bundled pneumatic tubes shall be run tight to the building structure or wall and shall be attached to the same at 3-foot intervals. Laying tubing on the ceiling is not acceptable.
 - e. All pneumatic tube and conduit shall run either parallel or perpendicular to walls constructed in the areas served. All takeoffs and tees from the bundles shall be made at 90 degree angles.
 - f. All instrument air lines installed in hot unoccupied spaces such as electrical vaults, steam tunnels, mechanical rooms with ventilation cooling only (no mechanical refrigeration), building attics and penthouses shall be run in hard or soft copper tubing. If the system is installed with polyethylene tubing each tubing termination or joint shall be provided with a metal clamping device such as a spring clamp in addition to the standard barbed fittings.
 - g. All instrument air mains and lines between the various system isolation valves and the room thermostats or controlling devices shall be tested.
 - h. All instrument air tubing between the instrument air supply (main) and the "main" air connections to control devices or control panels shall be tested for leakage. Instrument air piping upstream of pressure reducing valves shall be tested at 150 psig. All instrument air piping downstream of pressure reducing valves shall be tested at 50 psig. For all new work on the project (for projects up to 10,000 square feet work area) the test shall be completed at one time. For projects over 10,000 square feet, the project area may be broken into 10,000 square-foot increments to facilitate the construction schedule. Generally, the test shall include plugging all main air connections to terminal devices. Attach one 5-gallon portable pneumatic tank to the system for each 2,000 square feet being tested. Each tank shall be pressurized to 10 psig greater than the system test pressure. Pressurize the system, then bleed off excess tank pressure. The system shall pass the test if the pressure does not drop more than 5 psig in 24 hours.

10. All junction boxes and pull stations in the DDC conduit system shall be identified.

B. Installation - Software

1. Load all software as specified and required for an operational DDC system, including data bases, operational parameters, and all specified programs. Upon successful completion of the Endurance Test, provide two spare copies on CD ROM of source (excluding the general purpose operating system and utility programs furnished by the computer manufacturers) and object modules for all accepted software including diagnostics. Two sets of software, on media usable with the portable tester, containing all DCP software and diagnostics shall be provided.

2.15 WIRING PRODUCTS

A. The following wiring products shall be provided as required to suit project by the Controls Contractor. Wiring types provided shall be indicated on the shop drawings.

B. Wiring products shall be the product of ALFA Wire Corporation, Beldon Wire and Cable, or approved equivalent. ALFA Product numbers are provided to establish wire type, size, and materials of construction.

C. Non-plenum cable shall have passed the UL VW-1 flame test and shall have a PVC jacket which is approved for use in the city of Rockville.

1. Type "A" cable shall be 18 AWG copper minimum, shielded, with 2 conductors, 300 volt insulation, and an approved outer jacket suitable for non-plenum use, UL 2092. Type "A" cable shall be used for AI and AO functions. Type "A" cable shall be ALFA Wire Corporation Number 2422C.
2. Type "B" cable shall be 18 AWG copper minimum, unshielded, with 2 conductors, 300 volt insulation, and an approved outer jacket suitable for non-plenum use, UL 2509. Type "B" cable shall be used for low voltage BI and BO functions. Type "B" cables shall be ALFA Wire Corporation Number 1897C.
3. Type "C" cable shall be 14 AWG copper minimum with two single stranded conductors and 600 volt THHN insulation. Insulation colors shall be red and black. Type "C" cable shall be used for 120 volt BO functions. Type "B" cable shall be ALFA Wire Corporation Number 1859/19.
4. Type "D" cable shall be 18 AWG copper minimum, shielded, with 3 conductors, 300 volt insulation, and an approved outer jacket suitable for non-plenum use, UL 2093. Type "D" cable shall be used for AI and AO functions and for LAN and UCP-LAN communication functions. Type "D" cable shall be ALFA Wire Corporation Number 2423C.
5. Type "E" cable shall be 18 AWG copper minimum, shielded, with 4 conductors, 300 volt insulation, and an approved outer jacket suitable for non-plenum use, UL 2094. Type "E" cable shall be used for AO functions requiring power. Type "E" cable shall be ALFA Wire Corporation Number 2424C.
6. Type "F" cable shall be RG62A/U coaxial cable with an approved outer jacket. Type "F" cable shall be used for EAN communication functions. Type "F" cable shall be ALFA Wire Corporation Number 9062AC.
7. Type "G" cable shall be 18 AWG copper minimum, shielded, with 6 conductors, 300 volt insulation, and an approved outer jacket suitable for non-plenum use, UL2464. Type "G" cable shall be used for AI and AO functions and for communications between UCPs and UCP thermostats. Type "G" cable shall be ALFA Wire Corporation Number 6063C.
8. Type "H" cable shall be 18 AWG copper minimum, unshielded, with 4 conductors, 300 volt insulation, and an approved outer jacket suitable for non-plenum use, UL 2509.

Type "H" cable shall be used for low voltage BI and BO functions. Type "H" cable shall be ALFA Wire Corporation Number 1898/4C.

- D. Plenum cable shall be UL listed, Class 2 power limited circuit cable, type CL2P, for plenum applications without conduit, shall have passed the UL VW-1 flame test and the Steiner Tunnel Test for low smoke and flame generation, and shall have an FEP teflon jacket which is approved by the City of Rockville.
1. Type "AP" cable shall be 16 AWG copper minimum, shielded, with 2 conductors, 300 volt insulation, and an approved outer jacket suitable for plenum use, NEC 725-2(b), UL subject 13. Type "AP" cable shall be used for AI and AO functions. Type "AP" cable shall be ALFA Wire Corporation Number 58133.
 2. Type "BP" cable shall be 16 AWG copper minimum, unshielded as available, with 2 conductors, 300 volt insulation, and an approved outer jacket suitable for plenum use, NEC 725-2(b), UL subject 13. Type "BP" cable shall be used for low voltage BI and BO functions. Type "BP" cable shall be ALFA Wire Corporation Number 58131.
 3. Type "CP" cable is not permitted. All 120 volt BO functions must use Type "C" cable and conduit.
 4. Type "DP" cable shall be 16 AWG copper minimum, shielded, with 3 conductors, 300 volt insulation, and an approved outer jacket suitable for plenum use, NEC 725-2(b), UL subject 13. Type "DP" cable shall be used for AI and AO functions and for UCP-LAN communication functions. Type "DP" cable shall be ALFA Wire Corporation Number 58133. Use of Type "DP" cable for LAN communication functions shall not be permitted; use Type "D" cable and conduit.
 5. Type "EP" cable shall be 16 AWG copper minimum, shielded, with 4 conductors, 300 volt insulation, and an approved outer jacket suitable for plenum use, NEC 725-2(b), UL Subject 13. Type "EP" cable shall be used for AO functions requiring power. Type "EP" cable shall be ALFA Wire Corporation Number 58134.
 6. Type "FP" cable is not permitted. EAN communication functions must use Type "F" cable and conduit.
 7. Type "GP" cable shall be 16 AWG copper minimum, shielded, with 6 conductors, 300 volt insulation, and an approved outer jacket suitable for plenum use, NEC 725-2(b), UL Subject 13. Type "GP" cable shall be used for AI and AO functions and for communications between UCPs and UCP thermostats. Type "GP" cable shall be ALFA Wire Corporation Number 58136.
 8. Type "HP" cable shall be 16 AWG copper minimum, unshielded as available, with 4 conductors, 300 volt insulation, and an approved outer jacket suitable for plenum use, NEC 725-2(b), UL Subject 13. Type "HP" cable shall be used for low voltage BI and BO functions. Type "HP" cable shall be ALFA Wire Corporation Number 58134.
- E. When multiple runs of single conductor cables are employed the wiring shall be color coded in accordance with the Control Contractor's Standard for this facility.
- F. Wiring shall be UL listed and labeled for specific use. The approved outer jackets shall meet the approval of the city of Rockville for the specific application.
- G. Wiring for photoelectric and ionization type smoke detectors shall be provided in flexible metallic tubing to facilitate removal and cleaning of the detectors.
- H. Wiring for vibrating equipment including but not limited to fans, pumps, chillers, and boilers shall be provided in flexible metallic tubing.

2.16 PNEUMATIC TUBING PRODUCTS

- A. The following pneumatic tubing products shall be provided by the Controls Contractor.
- B. Non-metallic instrument air lines shall be an approved polyethylene tubing conforming to ASTM Specification D-1248, Type I, Class A, Category 4, Grade E5. The tubing shall be suitable for a working pressure of 150 psig at 73°F ambient. Tubing shall be 1/4 inch O.D. and 0.170 inch I.D.; minimum bend radius shall be 1 inch. Tubing shall be Parker Series E43, Dekoron F.R., or approved equal. Tubing shall conform to the requirements of the city of Rockville.
- C. Main instrument air lines shall be Type "L" hard or soft copper conforming to ASTM B-88 with soldered 50-50 tin lead solder using non-acid, non-corrosive flux. Fittings shall be cast brass or wrought copper sweat type conforming to ASTM B-75. Instrument air mains on individual floors shall be minimum 1/2" O.D. Instrument air risers shall be minimum 7/8" O.D. Connections to risers shall be provided with ball valves for isolation.

2.17 CONDUIT PRODUCTS

- A. The following conduit products shall be provided by the Controls Contractor.
- B. Conduits shall be light wall electrical metallic conduits selected for 40 percent fill unless otherwise noted.
- C. The conduit system shall be provided complete with connectors, adapters, pull stations and radius elbows as required.
- D. EAN wiring shall be installed in conduits employing long radius elbows; 90° bends shall not be permitted.
- E. Refer to Division 16 for requirements concerning conduit products.

2.18 OWNERSHIP OF PROPRIETARY MATERIAL

- A. The Owner shall retain all rights to software for this project.
- B. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition off this contractor. Such license shall grant use of all programs and application software to the Owner as defined by the manufacturer's license agreement, but shall protect the manufacturer's rights to disclosure of Trade Secrets contained within such software.
- C. The licensing agreement shall not preclude the use of the software by individuals under contract to the owner for commissioning, servicing, or altering the system in the future. Use of the software by individuals under contract to the owner shall be restricted to use on the owner's computers and only for the purpose of commissioning, servicing, or altering the installed system.
- D. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:
 - 1. Server and Workstation software
 - 2. Application Programming Tools
 - 1. Configuration Tools
 - 2. Addressing Tools
 - 3. Application Files
 - 4. Configuration Files
 - 5. Graphic Files
 - 6. Report Files
 - 7. Graphic Symbol Libraries
 - 8. All Documentation.

END OF PART 2

PART 3 – SYSTEM HARDWARE REQUIREMENTS

3.1 GENERAL

- A. This document defines the minimum hardware and performance requirements for a computer-based DDC system.

B. System Requirements

1. Provide all equipment, accessories, wiring and instrument piping required for a complete and functioning DDC system.
 - a. All materials and equipment used shall be standard components, regularly manufactured for this system and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use.
 - b. All embedded conduit shall be rigid conduit.
 - c. The DDC system shall be of a fully modular architecture permitting expansion by adding computer memory, application software, operator peripherals and field hardware.
2. Application Requirements
 - a. The DDC system shall meet the performance requirements of the following applications:
 - 1) Heating, Ventilating and Air Conditioning Control
 - 2) Air Handling Units
 - 3) Terminal Units
 - 4) Primary Equipment
 - 5) Energy Management Plan
 - 6) Historical Data Collection
 - 7) Monitoring of critical events
 - 8) Mass Flow Totalization
 - 9) Record all Information required to achieve the LEED Measurement and Verification credit.

3.2 SYSTEM DESCRIPTION

- A. Proposed system shall be UL listed and approved.
- B. General: The Contractor shall configure the DDC system as described herein. All computing devices, as defined in FCC Rules and Regulations, Part 15, shall be certified to comply with the requirements for Class A computing devices and labeled as set forth in FCC Rules and Regulations, Part 15.
- C. The system shall provide operator interaction and dynamic process manipulation, including overall system supervision, coordination, and control. Sensed data shall be obtained by DCPs which are located near the source of the data to be collected. DCPs shall manage all control functions within their Data Environment (DE) as specified.
- D. The operator's console shall have the capability to communicate with the DCPs located in remote facilities through a dial-up switched telephone network and with DCPs in the same facility by Local Area Network (LAN) on a scheduled basis and as directed by a system operator. Every connected analog output (AO), analog input (AI), digital output (DO), pulse input (PI), and digital input (DI) represents a "point" when referred to in the specification.
- E. Unitary controllers (UCPs) which are self-contained, stand-alone controllers, could be networked on a sub-network. These unitary controllers (also called application specific controllers) shall be considered "one point" (regardless of the fact that each of these may have several inputs and outputs).

- F. Systems that utilize sub-panels in a sub-network, in addition to UCPs, to DCPs shall indicate such panels by the designation DTC (data terminal cabinet). The DTCs are generally considered to denote panels for extending the I/O capacity of the DCP. The DTCs may or may not have their own processor.
- G. In general, any control panel connected to the highest level peer-to-peer network shall be called DCP. All panels in a sub-network to the DCPs shall be called DTCs. The application specific controllers (UCPs) may be on a sub-network to DCPs or to DTCs.
- H. All equivalency in proposers' hardware shall be clearly identified as such.
- I. System Accuracy and Display: All information shall be displayed and printed directly in engineering units with a format consistent with the range selected and matched to the full accuracy of the sensor, i.e., a static pressure sensor with a range of 0 to 0.25 inch water gauge (w.g.) with an accuracy of 0 to 0.25 percent, will be displayed in a + x.xxxx format.
1. An analog value input to the system's equipment via an AI shall have a maximum error of +0.10 percent of range, not including the sensor or transmitter error. This accuracy is required over the specified environmental conditions.
- J. Symbols, Definitions, and Abbreviations: All symbols, definitions, and engineering unit abbreviations utilized in information displays and printouts shall conform to the IEEE Standard Dictionary of Electrical and Electronic Terms and the ASHRAE Handbook of Fundamentals, where applicable.
- K. Environmental Conditions:
1. The DCP, Data Terminal Cabinets (DTC) and all other field equipment shall be rated for continuous operation under ambient environmental conditions of 35°F to 120°F dry bulb and 5 to 95 percent relative humidity, noncondensing. Equipment installed in a more severe environment shall withstand conditions as specified. If equipment is required to operate in such severe environments, appropriate environmental-type housings shall be furnished in accordance with the specification. Instrumentation and control elements shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.
 2. Operator's console shall be designated for continuous operation under ambient environmental conditions of 60° to 85°F and a relative humidity of 20 to 80 percent, noncondensing.
- L. Power Line Surge Protection: All equipment connected to AC circuits shall be protected from power line surges. Equipment protection shall meet the requirements of ANSI/IEEE C62.45-1987 and tested to UL 1449-1987. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms.
1. Test 1, Category A: 100 kHz ringwave of 6 kV at 200 amps
 2. Test 2, Category B: 100 kHz ringwave of 6 kV at 500 amps
 3. Test 1, Category B: 1.2 x 50 at 6 kV biwave; 8 x 20 at 3,000 amps
 4. Test 2, Category C: 1.2 x 50 at 6 kV biwave; 8 x 20 at 10,000 amps
- M. Sensor and Control Wiring Surge Protection: All digital and analog inputs and outputs shall be protected against surges induced on control and sensor wiring installed outdoors. The inputs

and outputs shall be tested in both normal mode and common mode using the following two waveforms.

1. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
2. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

N. Communication Link Surge Protection: All communication equipment shall be protected against surges induced on any communications link. All cables and conductors, except fiber optics, which serve as communication links from the operator's console to field equipment and between field equipment shall have surge protection installed at each end. Protection shall be furnished at equipment and additional protectors rated for the application on each wireline circuit shall be installed within three (3) feet of the building cable entrance.

O. Power Line Conditioners (PLC): PLCs shall be furnished for all operator's consoles equipment and each DCP. The PLCs shall provide both voltage regulation and noise rejection (both at low frequency and radio frequency). The PLCs shall be of the ferroresonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power line side. The PLCs shall be sized for 125 percent of the actual connected KVA load. Characteristics of the PLC shall be as follows:

1. At 85 percent load, the output voltage shall not deviate by more than +1 percent of nominal when the input voltage fluctuates between -25 percent to +15 percent of nominal.
2. During load changes of zero to full load, the output voltage shall not deviate by more than +3 percent of nominal. Full correction of load switching disturbances shall be accomplished within 3 Hertz, and 95 percent correction shall be accomplished within 2 Hertz of the onset of the disturbance.
3. Total harmonic distortion shall not exceed 3-1/2 percent at full load.
4. Minimum electromagnetic interference and radio frequency interference noise rejection shall be:
 - a. 20 KHz - 100 MHz - 60 dB normal mode
 - b. 20 KHz - 100 MHz - 40 dB common mode
5. All field equipment, including DCPs, DTCs, UCPs, ACPs (if applicable) shall have power line surge protection installed. As a minimum, Hubbell surge suppression receptacles shall be used.

3.3 DIRECT DIGITAL CONTROL PANELS (DCPs) – Also referred to as NIP's

- A. Direct Digital Control Panels are the highest level of controller that are connected to the local area network.
1. The DCPs shall be networked together to form a truly distributed control system. Any failure of a single controller (DCP) in the network shall not cause any other controller to fail. The DCPs shall communicate via a peer-to-peer, token passing or Ethernet protocol. Any DCP shall be capable of sharing information with any other DCP, without the need for a network master computer. It shall be possible to share information across the network in real time to be used for control purposes. The amount of time for control information to reach any DCP in the system shall be less than five seconds, regardless of network loading and the number of panels on-line. The network shall be capable of

- supporting a minimum of 255 DCPs on-line simultaneously. All data shall be displayable and changeable from any DCP in the system. The refresh rate of remote data (data at another DCP) being displayed shall be less than five seconds.
2. DCP shall be microcomputer-based with a minimum word size of 32 bits. (It is suggested that the proposers take exception to this item if necessary.) Output relays associated with digital signals shall be considered part of the Input-Output (I-O) function, whether physically mounted in the enclosure or separately mounted.
 3. The DCP shall include:
 - a. Main power switch.
 - b. Pneumatic filter regulator as needed
 - c. Locks on all cabinets. Locks shall be shall be keyed alike.
 4. Sufficient memory shall be provided to perform all specified and indicated DCP functions and operations. Memory shall be a minimum of 640 Kilobytes, expandable to 2 megabytes or larger.
 5. The DCP shall contain RAM/EPROM memory expandable to 64 Mbytes.
 6. The DCP shall calculate in floating point arithmetic. Fixed point arithmetic units will not be accepted.
 7. Each DCP shall have its own real time clock (RTC) with long-life battery back-up. The DCP shall systematically synchronize clock with the master clock in the system.
 8. A watchdog timer shall be provided in the system to supply a contact closure if the system fails to scan for any two-second interval.
 9. Internal back-up battery shall be provided on each DCP if the program is not contained in non-volatile memory. This back-up shall be for minimum of 72 hours.
 10. The analog inputs to the DCP or DTC shall be as follows:
 - a. Minimum analog to digital (A/D) conversion shall be 12 bits.
 - b. Input range shall be 4-20 ma current loop or industry standard 0-5 volts or 0-10 volts or 1000 ohm RTD.
 - c. Operating temperature shall be 32°F to 130°F, relative humidity 5 percent to 90 percent noncondensing.
 11. The analog output shall have minimum of 10 bits resolution for digital to analog (D to A) conversion. The output signal shall be 4-20 ma or industry standard 0-10 volts.
 12. The binary inputs/output (BI, BO) shall be selectable universal inputs or outputs and have the following minimum requirements.
 - a. Binary inputs shall be close contact, 24 volts to 240 volts AC or DC.
 - b. Binary output shall be 24 volts to 240 volts AC, switching to 3.0 amps.
 - c. Operating temperature shall be 32°F to 130°F, operating humidity shall be 10 percent to 90 percent non-condensing.
 13. A dedicated 120 volt AC, 15 amp, 60 Hz duplex outlet shall be furnished either inside or within 6 feet of the DCP enclosure.
 14. DCPs shall be housed in locking type mounting cabinets, with common keying and door switch. The DCP doors shall be alarmed and shall be monitored continuously and reported at the operator's console.
 15. Data Control Panel (DCP):
 - a. Each DCP shall have 20 percent spare capacity for I/O expansion after all the equipment has been connected to it, with 20 percent spare capacity for the building.
 - b. The DCP shall be provided with double-sided screw type terminal strips. One side of the terminal strip shall be used for termination of field wiring from instrumentation and controls. Terminal strip shall accept 12AWG stranded wire.

- The other side shall be used for connection to the DCP. All DCP and DTC circuit boards shall be plug-in type. Terminal strips shall have individual terminal identification numbers.
- c. The DCPs shall have at least one spare RS-232 serial port in order to accommodate a remote operator's CRT either by direct hardwire or via auto answer phone modem.
16. DCP Portable User Interface Device: Portable user interface devices for connection to any DCP shall be provided. Each DCP shall have the ability to accept connection of the portable user interface device to it. This interface device shall be ANSI X3.64 compatible and shall include a keyboard and display. The Owner shall supply this equipment. Coordinate the requirements with the Owner. The interface available at each DCP, shall include the following features:
- a. Initiate DCP Diagnostics
 - b. Display any digital and analog input, output or calculated point in the entire networked system at a summary and detailed level. Any dynamic information on any display, such as point value and status, shall be refreshed. The refresh rate shall be less than five seconds for all data.
 - 1) The operator interface shall be menu driven, allowing the operator to be directed in English language. System using codes or hexadecimal addresses shall not be acceptable.
 - 2) The data shall be obtained in multi-level hierarchical displays, such that data regarding a selected (highlighted) item on Level 1 can be displayed in full screen detail on Level 2.
 - 3) Displays referring to points, strategies, and equipment shall be user definable by the use of path names and wild carding.
 - 4) The summary level point display shall include, as a minimum, the point identifier, value, and status for a group of points. It should be possible for a group of points to span different DCPs.
 - 5) The detailed level point display information shall include, as a minimum, all user defined attributes of the point, such as point limits, alarm priority, etc. These attributes are in addition to the point value and status, which appear at the point summary level.
 - a. Modify any digital and analog input, output, or calculated point in the entire networked system at both the summary and detailed level.
 - 6) All information which the user can display as described above the user may change while it is being displayed. The user should be able to modify, as a minimum, all point values and statuses at the summary level. The user should be able to modify pertinent point attributes which may be displayed at the detailed level, including alarm limits, alarm priority, and hardware channel address as a minimum.
 - 7) Any input value, whether on this DCP or another DCP, which is modified by the user, shall automatically go to an off-line status to allow the user to quickly override any input in the system.

- 8) Any output or calculated value, whether on this DCP or another DCP, which is modified by the user, shall automatically go to a control override state. This will allow the user to quickly and immediately override any output or calculated point in the system.
 - a. It shall be possible to set all of the local real time clocks in all DCPs and modify the program in any or all DCPs (using appropriate passwords).
- 9) DTCs: the subpanels under the DCPs used to extend the data environment (DE) shall generally follow the same specifications for various types of I/O as the DCP.
- 10) The DCPs, DTCs, and UCPs shall not use fixed-point arithmetic. Any system using fixed-point arithmetic shall not be considered to meet the specification. There shall be no exceptions to this requirement.
- 11) I/O Functions:
 - a. Analog Inputs (AI): The AI function shall monitor each analog input, perform A-to-D conversion, and hold the digital value in a buffer for interrogation. Signal conditioning shall be provided for each analog input as necessary. Individually calibrate all analog inputs for zero and span, in hardware or in software. Input ranges shall be in the range of 4-20 mA DC. AI shall be a minimum of 12 bit resolution.
 - b. Analog Outputs (AO): The AO function shall accept digital data, perform D-to-A conversion, and output a signal in the range of 4-20 mA DC. Individually calibrate all analog outputs for zero and span. Short circuit protection on voltage outputs and open circuit protection on current outputs shall be provided. AO shall be minimum of 12 bit resolution and be a sourcing type signal.
 - c. Digital Inputs (DI): The DI function shall accept DE on-off, open-close, or other change of state (two state data) indications. Isolation and protection against an applied steady-state voltage up to 350 volt AC peak shall be provided. Fuses shall not be used for this purpose.
 - d. Digital Outputs (DO): The DO function shall provide contact closures for momentary and maintained operation of output devices. Closures shall remain closed for not less than 0.1 second. Electromagnetic interference suppression shall be furnished on all output lines to limit transients to non-damaging levels. Digital outputs shall be provided with solid state opto isolation with zero crossover for 3A. The digital outputs shall be fused for circuit protection.
 - e. Pulse Accumulator: The pulse accumulator function shall have the same characteristics as the DI, except that, in addition, a buffer shall be provided to totalize pulses and allow for interrogation by the DCP. The pulse accumulator shall accept rates up to 30 pulses per second. Contact debouncing circuits, if required, shall be furnished by the DDC System Supplier.
 - f. Signal Conditioning: Signal conditioning for sensors shall be provided as specified.
- 12) Provide completed details on the types of application specific panels (UCPs) that are available. In general, UCPs shall only be used on various types of terminal equipment.

3.4 DATA TERMINAL CABINETS

- A. The data terminal cabinets, also known as DTCs, are essentially extender panels to increase the point capacity of the DCP.
- B. The DTC may be an integral part of the DCP or may be separate from the DCP.
- C. The DTC shall be sized to accommodate the number of I/O functions required for each DCP. Each DCP as installed shall be provided with the capability for 25 percent expansion capability without a change in the DCP computer memory. This expansion may be provided by future addition of DTCs.
- D. The DTC shall be divided into analog and digital groupings, each with separate sensor and control signal wiring raceways.
- E. The DTCs shall be provided with screw type terminal strips. The terminal strip shall be used for termination of field wiring from instrumentation and controls. All DTC terminal strip connections to the DCP or data buss shall be plug-in type. Terminal strips shall have individual terminal identification numbers.
- F. All DC power supplies, interposing relays, and current to pressure transducers shall be located in the DTCs or in other ACPs.
- G. All DTCs shall be housed in locking type mounting cabinets with common keying and with door switch. Door switch shall alarm the DDC system monitoring station that the door is open. Refer to paragraph on apparatus control panels and other enclosures in this part of the specification for further requirements.
- H. All data cabinets shall be painted to match mounting wall color. Coordinate with Architect for finish colors.

3.5 UNITARY "APPLICATION-SPECIFIC" CONTROL PANELS (UCPs)

- A. Where specified, the DDC System Supplier shall furnish UCPs. UCPs are panels with built-in microprocessors used to control terminal equipment such as VAV terminal boxes, VAV terminal boxes with reheat, and fan coil units.
- B. UCPs shall be stand-alone microprocessor based control devices with networkable input and output capability. The device shall have sufficient memory to provide all specified operational functions. Refer to control sequences for requirements.
- C. All UCPs shall be networked to the higher level DCPs via a sub-network for monitoring and control from the central or remote operator's console level using non-proprietary public unitary protocol (PUP).
- D. It shall be possible to use UCPs from the same manufacturer on the same sub-network under a DCP if UCPs don't use PUP. The proposed system shall be able to use unitary controllers from all manufacturers that have open protocol.
- E. All UCPs shall have a jack receptacle provided at the thermostat for field operator communication to other UCPs on the network.
- F. Each UCP shall have sufficient I/O termination capacity for the specific application and spare capacity as specified in the General requirements..

- G. Enclosures for UCP circuit boards and terminal strips shall be plug-in type.
- H. Enclosures for UCPs will be NEMA 1 type or better.
- I. The low voltage power supply transformers, the transformer surge protection receptacle, and circuit protection for UCPs shall be furnished by the DDC System Supplier as required. No UCP shall be installed without providing minimal surge suppression in the power line, such as Hubbell surge suppression receptacles.

3.6 OPERATORS CONSOLES - CENTRAL STATION

- A. The existing station in the Science Center shall be used by extending the controls LAN into Science East.

3.7 INSTRUMENTATION - SENSORS, TRANSMITTERS, ACTUATORS, ETC.

- A. The DDC System Supplier shall be advised strict adherence to performance criteria and accuracy of instrumentation will be a requirement. In general, standard commercial grade components will not meet some of the criteria. The sequences of control shall specify the grade of instrumentation to use for various applications. The I/O summaries for control sequences shall provide this information. The transmitters for both Grades A and B instruments are the same. Grade C instrumentation may or may not require a 4-20 ma transmitter. The definition of instrumentation is as follows:

1. Grade A Instrumentation: This type of instrumentation is of the highest quality and shall be used in all laboratory spaces.
2. Grade B Instrumentation: This type of instrumentation is of high quality industrial and semi-industrial instrumentation, with accuracies typically in the range of 0.5 percent to 1.0 percent. This type of instrumentation shall be used for applications requiring accurate control of main air handling units, chillers, and controls for spaces such as class rooms, conference rooms, offices, and atriums.
3. Grade C Instrumentation: This type of instrumentation shall be used for unit heaters, cabinet heaters, and similar equipment serving mechanical equipment rooms, stairwells, etc.

- B. Transmitters Instrumentation

1. Transmitters: the term "transmitter" is defined as the electronic circuitry that accepts the signal from the sensor and after conditioning (if needed) transforms it into a 4-20 ma, or 0-10 VDC, signal. The term transmitter does not include the sensor which is also termed as transducer. It is also assumed in the specification that the transmitters on most industrial type sensors are to be located next to the sensor (transducer). Where indicated, the transmitters with field adjustable rangeability shall be provided. It shall be noted that all transmitters for Grade A and B instrumentation shall provide 4-20 ma or 0-10 VDC output. Specialized sensors with other types of outputs may be allowed with prior approval only on a case-by-case basis.

- a. All sensors, except the binary sensors, and temperature sensors shall be provided with a 4-20 ma DC or 1-10 volt DC output type transmitters, or RTD's suitable for the sensor being used. The accuracy of the transmitter shall be ± 0.5 percent of

the span. The stability shall be ± 0.012 percent of span/degree centigrade change in ambient temperature. The linearity shall be ± 0.05 percent of span. The transmitter shall be protected against damage caused by reverse polarity and supply voltage transients. The span required shall depend on the particular sensor and the application. A span and zero adjustment shall be provided at each transmitter to allow for recalibration when necessary. The transmitter circuitry shall be housed in an enclosure appropriate for the application and in conformance with NEC and the City of Rockville, MD, requirements. The operating temperature limits for ambient conditions shall be 32°F to 122°F or otherwise if stated for special applications.

2. The requirements listed above for transmitters serves to indicate the performance for this electronic component. The accuracy listed for sensors is assumed to include the requirements for the transmitters.
 3. Transmitters for Grade A and Grade B shall have switch-selectable ranges on the transmitter (e.g., 35°F to 60°F may be represented by 4-20 ma instead of -40°F to 150°F, etc.). Software range changes shall be acceptable.
 4. Where platinum RTD temperature sensors are specified in this section, 10 k-ohm thermistors are acceptable. Thermistors less than 10 k-ohm are acceptable only when a transmitter is required.
- C. Sensors for Grade B instrumentation. These are for use in large Air Handling Units, Central Pants components and non-laboratory spaces.
1. Space Temperature Transducers shall be factory calibrated. The sensor shall meet the following specifications:
 - a. Accuracy: ± 1.0 percent of span
 - b. Stability: ± 0.01 percent of span/degree C
 - c. Linearity: ± 0.05 percent of span
 - d. Span: 50°F minimum
 - e. Temperature Limits Ambient: 32°F to 122°F
 2. Duct and Liquid Temperature: Transducers Sensors used in liquid service shall be supplied with three (3) inch lagging extension stainless wells.
 - a. Accuracy: ± 0.5 percent of span
 - b. Stability: ± 0.01 percent of span/degree C
 - c. Linearity: ± 0.05 percent of span
 - d. Span: 50°F minimum
 - e. Temperature Limits Ambient: 32°F to 122°F
 3. Differential Temperature Transmitters shall be factory calibrated, field calibration or adjustment is not permitted. Transmitters shall be protected against damage from reverse polarity and line transients. The transmitter shall meet the following specifications:
 - a. Accuracy: ± 1.0 percent of span
 - b. Stability: ± 0.01 percent of span/degree C
 - c. Linearity: ± 0.05 percent of span
 - d. Span: 25°F maximum
 - e. Temperature Limits Ambient: 32°F to 122°F

4. Static Pressure Transducer: The operating range shall be selected to operate at approximately 75% of the range of the sensor.
 - a. Accuracy: ± 0.5 percent of span
 - b. Long-Term Stability: ± 1 percent of span per year
 - c. Span: 0.25 inch wc minimum to 10 inch wc maximum span
 - d. Overpressure: 25 inch ws without damage
 - e. Power Supply: 24 to 40 volts DC at 30 ma
 - f. Output: 1 to 5 volts DC, 0-10 VDC, 4-20 MA

5. Differential Pressure Transducer:
 - a. Accuracy: ± 0.5 percent of span
 - b. Long-Term Stability: ± 1 percent of span per year
 - c. Span: 0.25 inch wc minimum to 10 inch wc maximum span
 - d. Overpressure: 25 inch ws without damage
 - e. Power Supply: 24 to 40 volts DC at 30 ma
 - f. Output: 1 to 5 volts DC, 0-10 VDC, 4-20 MA

6. Gauge Pressure: The pressure transmitter shall incorporate direct electronic sensing with a completely sealed pressure cell. The unit shall use a differential capacitance sensing element that eliminates mechanical force transfer and the associated problems with vibration, shock and temperature.
 - a. Functional
 - 1) Overpressure: 2000 psig without damage
 - 2) Temperature: -20°F to $+200^{\circ}\text{F}$
 - 3) Power Supply: 24 to 40 volts DC at 30 ma
 - 4) Output: 4-20 ma DC
 - 5) Span: 5 inch wc minimum to 6000 psig maximum span

 - b. Performance
 - 1) Accuracy: ± 0.25 percent of span
 - 2) Linearity: ± 0.10 percent of span
 - 3) Hysteresis: ± 0.05 percent of span
 - 4) Repeatability: ± 0.05 percent of span
 - 5) Long-Term Stability: ± 0.25 percent of span per six months

 - c. Physical
 - 1) Diaphragms: 316ss
 - 2) Process Flanges: Carbon steel
 - 3) Process Connections: 1/4 NPT

7. Differential Pressure: The pressure transmitter shall incorporate direct electronic sensing with a completely sealed pressure cell. The unit shall use a differential capacitance sensing element that eliminates mechanical force transfer and the associated problems with vibration, shock and temperature.
 - a. Functional
 - 1) Overpressure: 2000 psig without damage

- 2) Temperature: -20°F to +200°F
 - 3) Power Supply: 24 to 40 volts DC at 30 ma
 - 4) Output: 4-20 ma DC
 - 5) Span: 5 inch wc minimum to 750 inch wc maximum span
- b. Performance
- 1) Accuracy: ± 0.20 percent of span
 - 2) Linearity: ± 0.10 percent of span
 - 3) Hysteresis: ± 0.05 percent of span
 - 4) Repeatability: ± 0.05 percent of span
 - 5) Long-Term Stability: ± 0.20 percent of span per six months
- c. Physical
- 1) Diaphragms: 316ss
 - 2) Process Flanges: Carbon steel
 - 3) Process Connections: 1/4 NPT
8. Liquid Flow Meter: Flow transmitters shall be of a two-wire 4-20 ma type, operating on a vortex shedding principle or a retractable insertion target meter and provide a current signal linear with flow. Transmitters shall be factory wet calibrated, field calibration or adjustment is not permitted. The transmitter shall be protected against damage from reverse polarity and line transients. The transmitter shall meet the following specifications:
- a. Accuracy: ± 1.0 percent of rate
 - b. Repeatability: 0.2 percent of span
 - c. Rangeability: 20:1
 - d. Temperature Limits: -40°C to +215°C
 - e. Ambient: -40°C to +65°C
9. Space Static Pressure Probe shall allow accurate space static measurement in the presence of radial air velocity sources. The probe shall be specifically designed for ceiling mounting.
- a. Accuracy: 1 percent of reading @ 1000 FPM Radial
 - b. Weight: Velocity
 - c. Finish: 8 oz. Brushed Anodized Aluminum
10. Air Flow Measurement Stations shall be complete with flow straightening section, multiple self-averaging velocity and static measurement probes, housed in a flanged duct section.
- a. Accuracy: ± 5 percent
 - b. Repeatability: ± 0.2 percent
 - c. Temperature: -200°F to 420°F
11. Electronic Air Flow Transducers: Transducers are electronic monitors of air mass flow in ducts. They measure mass flow directly, monitor low flows down to 0-100 SFPM, and do not need pneumatic hook-ups, square-root extractors or temperature and pressure corrections.
- a. Accuracy: 3 percent FS over 32°F to 122°F
 - b. Repeatability: 1 percent FS

- c. Response Time: 300 ms (to 63 percent of final flow)
 - d. Range: 0 to 200 FPM - 0 to 2000 FPM
 - e. Temperature: -4°F to 212°F
 - f. Output Signal: 100 to 300 ma
 - g. Input Power: 24 volts DC
12. Current to Pressure Transducer (I/P) shall be of industrial quality and capacity. Motor driven PRVs, switching solenoid valves, or position sensitive devices are not acceptable. The current to pressure transducer shall meet the following specifications:
- a. Supply Pressure: 25 psig \pm 2 psig
 - b. Linearity: \pm 1.0 percent of span
 - c. Span: 3-15 psig
 - d. Flow Rate: 4.5 SCFM @ 25 psig supply pressure
 - e. Air Consumption: 0.25 SCFM
13. Reheat Valve:
- a. Valves up to and including 1-1/4 inch shall have union connections. Valves 1-1/2 inch shall have screwed ends. All valves 2 inches and less in size shall be of high grade bronze.
 - b. All 2-way reheat control valves shall be PICCV characteristic ball valves by Belimo with corresponding actuator.
 - c. All 3--way reheat control valves shall be CCV characteristic ball valves by Belimo with corresponding actuator.
14. Dampers: Provide control dampers of the size indicated with a pressure class of not less than 150 percent of the system pressure at shut-off pressures capable of being developed by the related fan system. Dampers shall be selected to provide correct flow control characteristics as required for each individual application. Single blade height control dampers and room dampers shall be single blade dampers. The operating range shall be -50°F to 200°F.
- a. Provide Ruskin CD60
 - b. Type: Low leakage
 - c. Frame: 5 inch by 16 gauge hat-shaped steel
 - d. Blades: Air foil double skin 14 gauge
 - e. Seals: Blade edge-extruded vinyl; jam-aluminum flexible compression type
 - f. Linkage bearing: concealed in frame
 - g. Axles: molded synthetic 1/2 inch plated steel hex mill galvanized
 - h. Maximum Temperature: 250°F
15. Damper Actuators
- a. Actuators shall be electric (electronic).
 - b. All actuators shall be normally open (NO), normally closed (NC) or fail-in-last-position (FILP) as shown. Normally open and normally closed actuators shall be of mechanical spring return type.
 - c. Electric actuators shall have an electronic cut off or other means to provide burnout protection if stalled. Actuators shall have a visible position indicator.

- d. Electric actuators shall provide position feedback to the controller as shown. Actuators shall smoothly open or close the devices to which they are applied.
 - e. Electric actuators shall have a full stroke response time in both directions of 60 seconds or less at rated load. Electric actuators shall be the direct-coupled type.
 - f. Where multiple electric actuators operate from a common signal, the actuators shall provide an output signal identical to its input signal to the additional devices.
 - g. Valve Actuators: Valve actuators shall provide shut-off pressures and torques for the corresponding flow rates and system pressures.
 - h. Damper Actuators: Damper actuators shall provide the torque necessary per damper manufacturer's instructions to modulate the dampers smoothly over its full range of operation and torque shall be at least 6 inch-pounds per 1 square foot of damper area for opposed blade dampers and 9 inch-pounds per 1 square foot of damper area for parallel blade dampers.
 - i. Positive Positioning Devices: Positive positioning devices shall be a pneumatic relay with a mechanical position feedback mechanism and an adjustable operating range and starting point.
16. Humidity transmitter shall be two-wire, 4-20 ma output sensing device using bulk polymer resistance sensor technology.
- a. Transmitters shall meet the following specifications:
 - 1) Accuracy: ± 2 percent RH (± 2 percent RH is available)
 - 2) Span: 15 percent to 95 percent RH
 - 3) Operating Temperature Range: 30°F to 120°F minimum
 - 4) Temperature Affect: ± 0.06 percent per degree centigrade change in ambient temperature
 - 5) Manufacturer: Veris HT Series
 - b. Where temperature and humidity are being measured in the same room, the temperature and humidity transmitter shall be mounted on a common mounting bracket and covered with a common cover. Transmitter shall be Veris HT Series.
 - c. The humidity transmitter shall not be damaged when moisture condenser on the sensor itself.
17. Accelerometer: this sensor shall be piezoelectric type and shall be used for measuring vibration on equipment. The vibration shall be measured as analog quantity. Pre-set vibration switches shall not be acceptable.

18. Occupancy sensors: Sensors are provided by the electrical contractor.
 19. BTU Meter
 - a. Provide a microprocessor based instrument designed to provide full energy, flow and temperature data.
 - b. The corresponding flow meter, temperature sensors, and other relative components shall be provided by the same company that provides the BTU meter for a complete package.
 - c. The BTU unit shall have a serial connection with the BAS using the BACnet protocol. All points from the meter shall be accessible through the BAS.
 - d. Meter shall be custom calibrated and matched to an accuracy better than $\pm 0.15^{\circ}\text{F}$ from 32-200 $^{\circ}\text{F}$.
 - e. Meter shall be Onicon System 10 series or equivalent.
- D. Grade C Instrumentation. This is of the lowest quality commercial instrumentation with accuracies typically in the 1.0 percent to 5.0 percent range. This Grade C Instrumentation shall be used for unit heaters, cabinet heaters, and similar equipment serving mechanical equipment rooms, stairwells, etc.
1. Space Temperature Transducers shall be factory calibrated, field calibration or adjustment is not permitted. The transducers shall be protected against damage from reverse polarity and line transients sensors. The sensors shall meet the following specifications:
 - a. Accuracy: ± 2.0 percent of span
 - b. Stability: ± 0.01 percent of span/degree C
 - c. Linearity: ± 0.05 percent of span
 - d. Span: 50 $^{\circ}\text{F}$ minimum
 - e. Temperature Limits Ambient: 32 $^{\circ}\text{F}$ to 122 $^{\circ}\text{F}$
 2. CO2 Sensors: Wall mounted and incorporates the CARBOCAP sensor.
 - a. Accuracy: $\pm (2.0$ percent of span + 2 percent of reading)
 - b. Stability: $< \pm 5$ percent of range/5 years
 - c. Response time: 1 minute
 - d. Range: 0 to 2000 ppm (nominal)
 - e. Manufacturer: Vaisala specification as basis.
 3. Duct and Liquid Temperature Transducers shall be factory calibrated, field calibration or adjustment is not permitted. The transmitter transducers shall be protected against damage from reverse polarity and line transients. The sensor shall meet the following specifications. Transducers used in liquid service shall be supplied with three (3) inch lagging extension stainless wells.
 - a. Accuracy: ± 1.0 percent of span
 - b. Stability: ± 0.01 percent of span/degree C
 - c. Linearity: ± 0.05 percent of span

- d. Span: 50°F minimum
 - e. Temperature Limits Ambient: 32°F to 122°F
4. Differential Temperature Transmitters shall be factory calibrated, field calibration or adjustment is not permitted. The transmitter shall be protected against damage from reverse polarity and line transients. The transmitter shall meet the following specifications:
- a. Accuracy: ± 2.0 percent of span
 - b. Stability: ± 0.01 percent of span/degree C
 - c. Linearity: ± 0.05 percent of span
 - d. Span: 25°F maximum
 - e. Temperature Limits Ambient: 32°F to 122°F
5. Static Pressure Transducer: The sensor is constructed on a single printed circuit card. The input ranges are switch-selectable, offering both unidirectional and bi-directional pressure sensing settings.
- a. Accuracy: ± 2.0 percent of span
 - b. Long-Term Stability: ± 1 percent of span per year
 - c. Span: 0.25 inch wc minimum to 10 inch wc maximum span
 - d. Overpressure: 25 inch ws without damage
 - e. Power Supply: 24 to 40 volts DC at 30 ma
 - f. Output: 1 to 5 volts DC, 0-10 VDC, 4-20 MA
6. Differential Pressure Transducer: the sensor is constructed on a single printed circuit card. The input ranges are switch-selectable, offering both unidirectional and bi-directional pressure sensing settings.
- a. Accuracy: ± 2.0 percent of span
 - b. Long-Term Stability: ± 1 percent of span per year
 - c. Span: 0.25 inch wc minimum to 10 inch wc maximum span
 - d. Overpressure: 25 inch ws without damage
 - e. Power Supply: 24 to 40 volts DC at 30 ma
 - f. Output: 1 to 5 volts DC, 0-10 VDC, 4-20 MA
7. Space Static Pressure Probe shall allow accurate space static measurement in the presence of radial air velocity sources. The probe shall be specifically designed for ceiling mounting.
- a. Accuracy: 1 percent of reading @ 1000 FPM Radial
 - b. Weight: Velocity
 - c. Finish: 8 oz. Brushed Anodized Aluminum
8. Current to Pressure Transducer (I/P) shall be of industrial quality and capacity. Motor driven PRVs, switching solenoid valves, or position sensitive devices are not acceptable. The current to pressure transducer shall meet the following specifications:
- a. Supply Pressure: 25 psig ± 2 psig
 - b. Linearity: ± 2.0 percent of span
 - c. Span: 3-15 psig
 - d. Flow Rate: 4.5 SCFM @ 25 psig supply pressure
 - e. Air Consumption: 0.25 SCFM

9. Heating Control Valve:
 - a. Valves up to and including 1-1/4 inch shall have union connections. Valves 1-1/2 inch shall have screwed ends. All valves 2 inches and less in size shall be of high grade bronze. All valves 2-1/2 inches and larger shall have flanged ends, cast iron bodies and positive positioners.
 - b. All 2-way heating control valves shall be PICCV characteristic ball valves by Belimo with corresponding actuator.
 - c. All 3--way heating control valves shall be CCV characteristic ball valves by Belimo with corresponding actuator.

E. Binary Sensing Devices for Air Systems and Electric Control

1. General
 - a. Output signals from binary devices shall be SPST (N.O.) SPST (N.C.), SPDT, DPST (N.O.), DPST (N.C.) or DPDT signals as required by the application. All contacts shall be rated for a minimum of 7.4 amps at 120 volts AC inductive and 3.7 amps at 240 volts AC inductive or greater if required by the application.
 - b. All contact ratings and duties shall be rated in accordance with NEMA ICS1.
2. Temperature Switches
 - a. Temperature switches for duct application shall be remote bulb thermostats with an adjustable setpoint range of 20°F to 120°F. The changeover differential shall be adjustable between 6°F and 45°F.
 - b. Temperature switches for room temperature control shall include line voltage room thermostats. These devices shall be SPST or SPDT devices with a range of 40°F to 90°F and a changeover differential of 1.8°F to 3.5°F. These devices shall be suitable for heating or cooling duty for such applications as operating unit heaters or ventilation exhaust fans.
 - c. Low-voltage room thermostats shall be two-position temperature regulating instruments with anticipator circuits designed for close control of heating and/or cooling systems. These devices shall be suitable for 10 amps at 120 volts AC inductive. These devices shall have range of 45°F to 90°F and a changeover differential of 0.5°F for heating and 1.5°F for cooling. Room thermostats shall have an on-off-automatic switch to control the fan and heating-off-cooling switch to control functions. The thermostats shall have automatic changeover from heating to cooling and vice versa.
3. Freeze protection thermostats shall be snap-acting manual reset electrical devices which will contain a DPST switch. Freeze protection thermostats shall have a 20 foot capillary element, any portion of which, sensing a low temperature, shall activate the control to stop the supply fan. Sufficient freeze protection thermostats will be furnished to adequately protect the entire cooling coil. Thermostat range shall be adjustable 30°F to 55°F minimum.
 - a. Provide one freezestat for each 80 square feet of coil surface area.
 - b. The main set of contacts shall be wired to the fan starter; the auxiliary set shall be wired to the DDC system.

4. Pressure switches and differential pressure switches shall be diaphragm operated SPDT snap switches. Motion of the diaphragm shall be restrained by a calibrated spring that can be adjusted to set the exact pressure at which the electric switch will be actuated. Switches shall be suitable for a minimum of 25 inches w.g. pressure or differential pressure without damage.
 - a. Switch ranges shall be selected to fall within the switch scale based on 80 percent of the "measured" devices rated pressure or differential pressure.
 - b. Switches shall be Dwyer Series 1910, Cleveland AFS 460 or approved equal.
5. No sail switches shall be used.
6. Vibration switches shall be acceleration sensitive devices that measure the total peak vibratory shock. The device shall provide electric switch contact closure for shutdown of fans, pumps, or compressors. The device shall be DPDT for direct wiring to the equipment and to the DDC system. The setpoint shall be field adjustable between 0 and 4.5 Gs in a frequency range of 0 to 50 Hz. The device shall be manual reset.
 - a. The main set of contacts shall be wired directly to the fan, pump, or compressor starter; the auxiliary set shall be wired to the DDC system.
 - b. Devices shall be Vibra-Alert Model 5173 or 5175 vibration switches or approved equal.
7. Damper End Switches
 - a. Damper end switches for new smoke dampers and for new combination fire/smoke dampers shall be furnished with each new damper provided by the HVAC Contractor.
 - b. Damper end switches for existing smoke dampers and for existing fire and smoke dampers shall be provided by the DDC System Supplier and shall be the same switches which would be furnished as the standard offering of the "existing" damper manufacturer.
 - c. Damper end switches used for outdoor air, return air, and relief air dampers in engineered smoke control systems shall be provided by the DDC System Supplier.
 - d. Damper end switches, unless otherwise specified, shall be low operating torque spring return NEMA 13 oil tight limit switches with "cat whisker" operating lever. End switch shall be provided complete with rigid mounting bracket for attaching switch to a "fixed" surface and a rigid for attachment to the movable portion of the damper as required. Damper end switch shall be Allen Bradley Catalog #302T-CW or approved equal.
8. Jumbo pushbutton for labs shall be NEMA 13 oil tight mushroom head momentary contact spring return pushbutton units complete with legend plate and flush wall plate and guard. Pushbutton shall have one N.O. and one N.C. set of contacts.
 - a. Legend plate shall read, "Emergency."
 - b. Pushbuttons shall be Allen Bradley Catalog #800H-DGB (red) with #800T-N151 guard or approved equal.

9. Other control devices such as manually operated selector switches and pushbuttons shall be industrial quality switches, selected for the specific application. Switches shall be a minimum of NEMA 13 oil tight.
 - a. All switches shall be the standard products of Allen Bradley, Cutler Hammer, Westinghouse, or approved equal.

F. Binary Sensing Devices for Water Systems

1. General
 - a. Output signals from binary devices shall be SPST (N.O.), SPST (N.C.), SPDT, DPST (N.O.), DPST (N.C.), or DPDT signals as required by the application. All contacts shall be rated for a minimum of 7.4 amps at 120 volt AC inductive and 3.7 amps at 240 volts AC inductive or greater if required by the application.
 - b. All contact ratings and duties shall be rated in accordance with NEMA ICS1.
2. Temperature Switches
 - a. Temperature switches (aquastats) shall be surface mounted electric thermostats designed for mounting directly onto pipes. These devices shall be SPDT devices with a range of 50°F to 150°F and a changeover differential of approximately 10 °F. These devices shall be suitable for such applications as operating unit heaters.
 - b. Remote bulb temperature switches shall be electric thermostats used where remote or immersion sensing is required. These devices shall be SPDT devices with ranges of 20°F to 120°F or 100°F to 240°F and an adjustable changeover differential of between 6°F and 45°F.
 - c. Immersion sensing elements shall be provided complete with thermometer wells.
3. Pressure switches shall be SPST (N.O.) type operated by a stainless steel bourdon tube actuating a mercury switch. Switch shall be rated for a minimum of 300 (150) psig operating pressure with a minimum adjustable operating setpoint of 10 psig. Deadband shall be adjustable up to 100 percent of the switch range. Switch shall have a visible calibrated dial and two visible pointers indicating setpoint and reset point and shall have visible on/off indication.
 - a. Pressure switches shall be Mercoïd Series DA-41 or approved equal.
 - b. Pressure switches shall be provided complete with snubber.
4. Differential pressure switches shall be SPST (N.O.) type operated by two opposing double bellows actuating a mechanical linkage. Switch shall be rated for a minimum of 300 (150) psig operating pressure with a minimum adjustable operating differential setpoint range of 0 to 30 (20) psig; deadband shall be adjustable 6 to 30 (20) psig. Switch shall have a visible calibrated dial and two visible pointers indicating setpoint and reset points.
 - a. Differential switches shall be Mercoïd Series DP-7043-153 or approved equal.
 - b. Each pressure sensor leg shall be provided complete with snubber.

5. Paddle type flow switches shall be SPDT or DPDT switches as required by the application and shall be constructed with stainless steel parts being in contact with the water. The switch shall be suitable for installation in a female NPT pipe opening. The switch shall be rated for a minimum of 300 (150) psig operating pressure. The operating flow rate (flow - no flow) shall be adjustable.
 - a. Flow switch shall be McDonnell Miller Series FS7-4 (FS4-35) or approved equal.
 - b. Time delay relays shall be provided for switches which operate directly with the pump starter.

6. Level Switches
 - a. Float operated level switches shall be float actuated level switches for turning pumps on and off and opening and closing valves to maintain level. The device shall also alarm and cut-out on low level. The device shall be rated for minimum 150 psig operating pressure and shall be complete with sight glass. Float switch shall be McDonnell Miller No. 157 Pump Controller/Low Water Cut-Off or approved equal.
 - b. Float operated level switches for tank level detection and control shall be vertical displacer type with up to four (4) displacers and three (3) SPST switches. The number of displacers and switches shall be determined by the application. Displacers shall be porcelain or stainless steel. Displacer housing shall be supported on a cast iron flange. Switch shall be provided with a vented stilling chamber. Switch shall be McDonnell Miller Model DFC with mercury switches or approved equal.
 - c. Probe actuated level switches shall be single or multiple conductance actuated controls which utilize electrodes and the conductivity of the fluid to sense liquid level. The number of probes (up to four) and switches shall be determined by the application. The control housing shall be suitable for inserting in vessels with pressures up to 250 psig. Probe shall be suitable for 120 volt pilot voltage. The switch shall be provided with a vented stilling chamber. Switch shall be McDonnell Miller Model PCH-G-A or approved equal.

7. Current switches for pumps shall be designed to mount in the starter enclosure on a power lead of the device to be monitored and energize a solid-state switch when the current level rises above the trip point. The trip point shall be easily knob adjusted from the front of the switch and the trip point shall have a differential of ± 5 percent of full range. The switch shall be powered from the starter control transformer and shall have overcurrent protection to 200 percent of the upper range limit. The output shall be a SPST (N.O.) switch, rated at 120 volts AC.
 - a. Current switches shall be Cymatics Model 850 or approved equal.

8. Reed relays shall be used for conversion of a single pulsed input to a multiple pulse input. This would happen where a single meter with a single pulse output used in a pre-packaged control process would be monitored by the DDC system; i.e., to determine cooling tower water consumption from the chemical feed system water meter. The purpose is to convert one "long duration pulse" into several "short duration pulses."
 - a. Outputs from relays shall be multiple SPST (N.O.) signals as required by the sequence of operation. All contacts shall be rated for low-energy switching at a maximum 150 volts AC, 500 ma, 25 VA maximum.
 - b. All contacts ratings shall be rated in accordance with ICS1.

- c. Relay holding coils shall be rated for available input current and voltage and for continuous duty if necessary. Relays shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage.

G. Other Output Devices

1. Control Relays: All control relays interfacing to AC circuits shall be solid state with zero crossing, capable of handling 240V AC at 3A.
2. Electric Solenoid Operated Pneumatic (EP) Valve: EP valves shall have three port operation: common, normally open, and normally closed. EP valves shall have an outer cast aluminum body with internal parts constructed of brass, bronze, or stainless steel. The air connection shall be a 3/8 inch NPT threaded connections. EP valves shall be rated for 50 psig when used in control system operation at 25 psig or less, or rated at 150 psig when used in control system operation from 25 to 100 psig. EP coils shall be equipped with transient suppression to limit transients to 150 percent of rated voltage. EP valve operation shall be rated for a minimum of 220°F.
3. Single Input Control Point Adjustment (CPA) Controller: Single input CPA controllers shall permit changing of control points remotely by varying the CPA port value. CPA shall be plus or minus 10 percent of primary sensor span. Controllers shall operate from electronic or pneumatic sensors as shown. Controllers shall be complete with adjustable setpoint, adjustable gain (proportional band) and shall be field selectable for direct or reverse action. Pneumatic units provided shall be constructed to withstand a maximum pressure of 25 psig. All controller inputs and outputs shall be provided with internal or external gauges for calibration on input and output signals.
4. Dual Input Controller: Dual input controllers shall permit changing of control points remotely by varying the second port input value. Controllers shall operate from electronic or pneumatic sensors as shown. Controllers shall be complete with adjustable setpoint, adjustable gain (proportional band), adjustable authority, and shall be field selectable for direct or reverse action. Authority effect of secondary sensor on setpoint shall be adjustable from 33 to 100 percent of primary sensor span. Pneumatic units shall be constructed to withstand a maximum pressure of 25 psig. All controller inputs and outputs shall be provided with internal or external gauges for calibration of input and output signals.
5. Position Sensors
 - a. End (Limit) Switch: Limit switches shall be of the enclosed or sealed type as required for the application. Contacts shall be snap-action Form C rated for the application.
 - b. Potentiometers: Potentiometers may be either rotary or linear, depending on the application of each position indicator. Position potentiometers shall have a linearity of plus or minus 5 percent and shall indicate position on a percent open basis.

H. Analog Output Devices

1. General
 - a. The analog outputs from the DCPs shall generally be a 4-20 ma or 0-10 volt signal which will be used either to control the setpoint of "external" devices as 4-20 ma input (i.e., a variable frequency drive) or to control a pneumatic output device (i.e., a valve or damper).

- b. All control signals to "external" devices shall be protected from surges induced on the control wiring on each end. These "inputs" and outputs shall be tested in both normal mode and common mode using the following waveforms:
 - 1) A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 - 2) An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
 - c. All control signals to pneumatic control devices shall have the signal converted from (4-20 ma or 0-10 VDC to pneumatic via a current to pneumatic (I/P) or voltage to pneumatic (E/P) transducer.
2. Pneumatic (I/P, E/P) Transducers
 - a. Transducers shall meet the following specifications:
 - 1) Supply pressure: 25 psig \pm 2 psig
 - 2) Signal: 4-20 ma or 0-10 v
 - 3) Output pressure: 3-15 psig
 - 4) Linearity: \pm 1.0 percent of span at 25 psig supply
 - 5) Flow Rate, Midrange: 4.5 SCFM at 25 psig
 - 6) Air Consumption, Midrange: 0.1 SCFM
 - 7) Supply Pressure sensitivity, Midrange: \pm 1 percent of span per psig
 - 8) Minimum Overpressurization without Damage: 30 psig
 - b. Each transducer output signal shall be provided with a minimum 1 inch diameter pressure gauge or LCD display.
 - c. Outputs from transducers shall be used to control valves, control dampers, or to reset pneumatic control setpoints.
 - I. Electrically Actuated Dampers and Valves
 1. When called for or allowed in the specification, electronically actuated valves and dampers shall be provided in lieu of pneumatically actuated devices.
 2. These actuators shall be provided in adequate size and quantity to properly position each automatic control device.
 3. Refer to pneumatically actuated dampers and valves in the specification for further requirements pertaining to valve and dampers.
 4. Electronic Actuators - General
 - a. Electronic actuators shall be selected for valves and dampers based on the torque and thrust requirements of the device to be controlled.
 - b. Actuators for valves and dampers shall be designed to operate in environments between 35°F and 140°F. Actuators for outdoor air dampers shall be designed to operate in environments between -4°F and 122°F.
 - c. Actuators shall have a minimum five-year replacement warranty.
 - d. All valve and terminal box actuators shall be shipped to the valve and terminal box manufacturer for mounting. Mounting costs shall be borne by the DDC System Supplier.
 - e. Electronic actuators shall be permitted for all applications except where noted on drawing M800.
 5. Electronic Damper Actuators

- a. Electronic damper actuators for smoke dampers shall be standard electronic actuator. These actuators shall meet the following requirements:
 - 1) Full close to full open stroke time shall be five minutes maximum.
 - 2) Modulating dampers shall modulate or position itself using an electronic motor and, in conjunction with damper arm as required, shall create a minimum of 133 inch-pounds of torque. Multiple actuators shall be used where higher torque requirements are required.
 - 3) Modulating damper positioning shall be controlled using a controlled output signal or the damper actuator shall be provided with positive positioning feedback.
 - 4) Open close damper positioning shall be controlled using an on/off closure and shall be provided with end switches.
 - 5) Upon power loss, the damper actuator shall "spring return" to a normally open or normally closed position as specified in the control sequences.
 - 6) Damper actuator shall be provided with a visual damper position indication on the actuator body.

6. Electronic VAV Box damper and Reheat coil valve actuators:
 - a. Actuators
 - 1) Electronic dampers actuators for equipment shall be electronic actuator. These actuators shall meet the following requirements.
 - 2) Full open close stroke time shall be 120 seconds or less
 - 3) Actuators shall be Underwriters Laboratories approved under standard 873
 - 4) Actuators used near outdoor air streams shall have NEMA type 2 housing for water and moisture
 - 5) Actuators shall be direct couples to the valve
 - 6) Actuators shall be applied as per manufacturer's specifications
 - 7) The valve Actuators shall be capable of providing the minimum torque required for proper valve close-off pressure for the required application.
 - 8) Actuators shall have current limiting circuitry or overload protection
 - 9) Applications that require fail safe operation of the valve assembly shall use actuators with mechanical springs.
 - 10) Interior valve shall fail to last position.
 - 11) All proportional valves shall be positive positioning and respond to a 2-10 VDC or 4-20 ma signal. Positioning shall be within 0.5 percent of stroke. The actuator shall provide positive positioning feedback. Floating point actuators shall not be allowed.
 - 12) Actuators shall operate on 24 volts AC power.
 - 13) Manufacturer shall provide a 5 year unconditional warranty.

 - b. Valves
 - 1) Valves 1/2" through 2" shall be forged brass body with nickel plating, NPT screw type. The operating temperature range shall be 0 Deg. to 212 Deg. F.
 - 2) The valves shall have an ISO 4 bolt flange for mounting actuators in any orientation. A non-metallic thermal isolation adaptor shall separate the flange from the actuator with high temperature material rated for continual use at greater than the application temperature. Valves assemblies without thermal isolation shall not be acceptable.
 - 3) Valves up to and including 1-1/4 inch shall have union connections. Valves 1-1/2 inch shall have screwed ends.

- 4) The isolation adaptors shall provide stable direct coupled mechanical connection between the valve body and actuator and prevent lateral or rotational forces from affecting the stem and its packing O-rings.
- 5) All control ball valves shall be furnished with a stainless steel ball and stem and fiberglass reinforced Teflon seats and seals. The valves shall have a blow out proof stem design. Each valve shall be tested by the valve manufacturer.
- 6) Flow type for modulating two way and three way valves shall be equal percentage. All control valves shall have a flow characterizing disc in the inlet of the valve to provide the equal percentage control port. They shall have a modified linear bypass port which will yield 70% of the flow of the A port.
- 7) Manufacturers shall provide a two year unconditional warranty from the date of acceptance.
- 8) 2-way valves shall be Belimo PICCV valves with a Belimo electric actuator rated for the application.
- 9) 3-way valves shall be Belimo CCV valves with a Belimo electric actuator rated for the application.

7. Isolation and Modulating Water Control Valves:

a. AHU Chilled Water Coil Control Valves

- 1) Prove Belimo electronic actuator sized and rated for the application.
- 2) Valves shall be Delta P valves by Flow Control Industries (FCI).

b. Other Control Valves over 2-1/2"

- 1) Valves shall be high-performance Butterfly valves by Belimo.
- 2) Valves shall meet the performance requirements in Specification Section 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING
- 3) Prove Belimo electronic actuator sized and rated for the application.

c. Other Modulating Control Valves 2-1/2" or smaller

- 1) Valves shall be as specified above in section 3.13.J.6.b
- 2) Prove Belimo electronic actuator sized and rated for the application.

d. Other Two Position Control Valves 2-1/2" or smaller

- 1) Valves shall ball valves by Belimo that meet the performance requirements in Specification Section 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING
- 2) Prove Belimo electronic actuator sized and rated for the application.

J. Miscellaneous Electrical Equipment

1. Relays

- a. Socket Mounted Relays - 5 Amp Contacts: Relays shall be three pole double throw socket mounted devices with an octal pin type or blade type mounting arrangement. Contacts shall be rated for 5 amps at 120 volts AC. Coil voltage shall be as specified on the drawings or equipment lists and shall draw no more than 2.5 VA. Relays shall be provided with mounting sockets with screw type terminals and shall be suitable for mounting on a standard DIN EN 50022 mounting rail. Relays shall be provided with a manual test button for check-out and troubleshooting purposes. Acceptable devices and manufacturers are as follows:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Potter & Brumfield	KUP14A25 relay	
Iddec	RR3PA-UC relay RR3B-UC relay	
Omniron	MJ3PI-UA relay	

- b. Multi-Function Programmable Time Delay Relay: Time delay relay shall be capable of performing as a delay on make, delay on break, or interval timer depending on DIP switch programming or terminal jumpering. Relay time delay range shall be from 0.5 seconds minimum to 2 hours or more. Relay output shall be at least 1 set of single pole double throw contacts rated for at least 5 amps at 120 volts AC. Mounting shall be in a screw terminal type socket provided with the relay. The socket shall be suitable for mounting on a standard DIN EN 50022 mounting rail. Relay power supply voltage shall be as specified on the drawings or parts list or required for proper operation. Acceptable manufacturers and models are as follows:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Automatic Timing & Controls Co.	328A200 relay	
Barber Colman	P-186-8-2 relay	
Guardian	PET 1481 relay	
Syrelec	LR2 Series	

- c. Cube Type On-Delay Relay: Relays shall be series wired on delay relays with the voltage and time delay ratings indicated on the drawings and parts lists. Relays shall be arranged to be wired in series with the load they serve. Adjustable time delay range, where specified, shall be provide with potentiometer wired to auxiliary terminals at the relay or programmed by DIP switches mounted at the relay. Terminals shall be screw type or quick connect spade type. Where adjustable delay ranges are specified, the relay shall be provided with all necessary accessories required to provide the adjustable range. Relays shall be capable of switching loads up to 1 amp at the input voltage specified. Acceptable manufacturers and models are as indicated below:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
National Controls Corporation	Q1 series	
Artisan	438U or 438USA or 438UP or 438 or 438AP	
Idec	RTS-MN	
Syracuse	SMPA or SMPB	

- d. Cube Type Off-Delay Relay: Relays shall be off delay relays with the voltage and time delay ratings indicated on the drawings and parts lists. Timing shall be initiated by the opening of an isolated external contact. Adjustable time delay range, where specified, shall be provided with a potentiometer wired to auxiliary terminals at the relay or programmed by DIP switches mounted at the relay. Terminals shall be screw type or quick connect spade type. Where adjustable delay ranges are specified, the relay shall be provided with all necessary accessories required to provide the adjustable range. Relays shall be capable of switching loads up to 1 amp at the input voltage specified.

1) Acceptable manufacturers and models are as indicated below:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
National Controls Corporation	Q3 series	
Artisan	4710	
Syracuse	SBPA	

2. Switches, Potentiometers, and Lights

- a. Multi-Pole, Multi-Step Rotary Switch: Switches shall be panel cover mounted switches with operator and numbered legend panels. Poles and steps shall be as required by the application or as indicated on the drawings. Contacts shall be rated for 10 amps at 120 volts AC. Provide a placard for each switch to be mounted with the switch indicating the function of each position. Acceptable manufacturers and models are as follows:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Entrelec	VY10 Family	

- b. Push to Test Pilot Lights: Pilot lights shall be suitable for cover mounting in control panels and shall be rated for the voltage associated with the application. Lens colors shall be as specified or as required by the application. Lamps and holders shall be the push-to-test type with the words "Push To Test" or "Press To Test" clearly engraved or cast into the lens cap. Lamps shall be provided with legend plates indicating the function associated with illumination of the lamp.
- c. Momentary Contact Push-Buttons: Switches to be panel mounted single pole single throw normally off momentary on rated for a minimum of 3 amps at 120 volts AC. Buttons shall be color coded as indicated on the drawings or parts list. Switches to be supplied with all accessories required for panel mounting. Switches to have screw type terminals. The following devices and manufacturers are acceptable:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Idec	TWTD Series TW Series	
Allen Bradley	800MS Series 800MR Series	
Rafix	22/30 Series	

- d. Toggle Switches - Single Pole Single Throw: Switches to be panel mounted single pole single throw two-position switches with both positions maintained. Contacts to be rated for a minimum of 15 amps at 120 volts AC. Switches to be supplied with all accessories required for panel mounting. Switches to have screw type terminals. The following devices and manufacturers are acceptable:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Idec	TWTD Series TW Series	
Allen Bradley	800MS Series 800MR Series	
Rafix	22/30 Series	

- e. Toggle Switches - Single Pole Double Throw: Switches to be panel mounted single pole double throw three position (center off) switches with all positions at 120 volts AC. Switches to be supplied with all accessories required for panel mounting. Switches to have screw type terminals. The following devices and manufacturers are acceptable:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Idec	TWTD Series TW Series	
Allen Bradley	800MS Series 800MR Series	
Rafix	22/30 Series	

- f. Panel Cover Mounted 10 Turn Clock Face Potentiometers: Potentiometers shall be panel cover mounted devices with 10 turn clock face dials and shall be rated for the voltage and current of the circuit they are serving. Acceptable devices and manufacturers are as follows:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Bourns	3600S-1	
Bourns	3640S-1	

- g. Trimmer Potentiometer: Trimmer potentiometers shall be internally mounted at terminal strips in control panels and shall have values as required by the application. Pots shall have a screwdriver type multi-turn adjustment accessible with the device in its normal mounted position. Mounting terminals shall be of the sliding link type to allow the device to be isolated from the circuit it serves for set up. Devices shall be rated for the voltage and current of the circuit they are installed in. Acceptable manufacturers and models are as follows:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Bourns	20 3006 3009 3099P	

3. Temperature and Pressure Control Switches

- a. Two-Position Electric Thermostat: Thermostats shall be snap-acting type thermostats with SPDT contacts rated for a minimum of 1.5 amps inductive at 120 volts AC. Cover arrangements shall be as specified or as directed by the Engineer at the time of shop drawing review. Minimum setpoint range shall be 55° to 85°. Acceptable manufacturers and models are as follows:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Landis & Gyr Powers	ET-134 Series	
Honeywell	T651A	
White Rodgers	1A16-51	

- b. Remote Bulb Thermostat - Single Pole Double Throw: Thermostats shall be thermally actuated single pole double throw switches with a field adjustable setpoint and differential. Differential range of adjustment shall be a minimum of 6 to 12°F. Minimum setpoint range of adjustment shall be as indicated below. Switch contacts shall be rated for a minimum of 6 amps inductive load at 120 volts AC, 3 amps inductive load at 240 volts AC. Capillary length shall be a minimum of 6 feet. Where indicated, thermostats shall be supplied with two wells (one for calibration and one for bulb installation). Acceptable devices and manufacturers are as follows:

<u>RANGE OF ADJUSTMENT DEGREES F</u>	<u>LANDIS & GYR</u>
20 to 100	141-0520
100 to 240	141-0521

4. Current Operated Switches

- a. General: Current operated switches shall be provided with additional relays as required to perform the indicated functions in the sequences of operation. In addition, contact resistance associated with solid state relays shall be taken into consideration and accounted for in the design of the circuits using solid state relays to prevent problems associated with voltage drops through closed switches and leakage currents through open switches.
- b. Current Operated Switch - Low Range: Devices shall be capable of changing the state of an isolated dry contact or switch when a flow of current is sensed in the wire they are monitoring. The isolated output must be capable of switching up to 1 amp at 120 volts AC or DC minimum as required by the application. Trip points shall be adjustable from a minimum of 2 amps to a maximum of 15 amps. Devices shall be provided with all necessary mounting hardware. Acceptable manufacturers and models are as follows:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Potter and Brumfield	SDAS-01 Series	With mounting socket
Neilsen – Kuljian	D-100AC	

- c. Current Operated Switch - High Range: Devices shall be capable of changing the state of an isolated dry contact or switch when a flow of current is sensed in the wiring they are monitoring. The isolated output must be capable of switching up to 1 amp at 120 volts AC or DC minimum as required by the application. Trip points shall be adjustable from minimum of 15 amps to a maximum of 300 amps. Devices shall be provided with all necessary mounting hardware. Acceptable manufacturers and models are as follows:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Neilsen - Kuljian	D-100AC	

5. Pressure Switches

- a. Differential Pressure Switches - Pump Proof of Operation: Switches shall be arranged to actuate a single pole double throw switch based on the difference between two pressures. Switches shall be bellows actuated. Switches shall be suitable for the working pressure of the system on which they are installed and shall have a minimum working pressure rating of 30 inches Hg vacuum to 100 psig. The setpoint shall be adjustable between 0 and 20 psig and the sensitivity shall be adjustable with a minimum setting of 1 psig. Switches shall be rated for a minimum of 5 amps at 120 volts AC. Enclosures shall be rated NEMA 1 and shall be provided with termination points for conduit and piping connections. Switches shall be Mercoid series DPA or approved equal by United Electric or Penn.

K. Miscellaneous Auxiliary Equipment

1. 24 Volt AC Control Power Transformers: Transformers shall be NEC Class 2 general purpose transformers with primary windings as required by the application and 24 volt AC secondary windings rated for 40 VA at 100 percent power factor. Transformers shall be installed in a suitable enclosure to prevent contact with the primary and/or secondary terminals when the cover is on the enclosure. Where transformers are provided for

installation by others, the transformers shall be provided mounted in the enclosure. The mounting arrangement shall be such that the terminals are accessible for connection without removing the transformer from the enclosure.

- a. Transformers shall be Honeywell AT72D series with suitable NEMA 1 enclosure or approved equal.
- b. Similar transformers with higher VA ratings may be supplied but must be designed and installed to meet all requirements of NEC article 725 when used to serve Class 1, Class 2, or Class 3 low voltage circuits. Transformers shall be UL labeled.
- c. Disconnecting Terminal Blocks: Terminal block shall be arranged to allow the entering conductor to be disconnected from the leaving conductor without lifting the conductor from its termination point. Disconnection shall be by screwdriver actuated sliding link, knife link, or plug switch. Terminals shall be rated for the voltage and current of the circuit they are contained in at a minimum. Termination points shall be arranged with test jacks to allow a meter to be connected without interfering with the operation of the disconnecting means. Terminals shall be suitable for and mounted on a standard DIN EN 50022 mounting rail. Acceptable models and manufacturers are as follows:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Weidmuller	SAKC10	
Weidmuller	SAKT1	
Weidmuller	SAKT2	
Entrelec	4/6.SNT	
Entrelec	M6/8.ST2	
Phoenix	URTK/SP	
Phoenix	MTK-P/P	
Phoenix	UK4-T	

1) All of the above are with accessories as required for a complete assembly.

- d. Fuse Holder Terminal Blocks: Terminal block shall be arranged to allow a fuse to be installed in the terminal strip between the entering and leaving wires of the termination point. Terminals shall be provided with LED, Neon, or mechanical fuse status indicators. Terminals shall be rated for the voltage and current of the circuit they are contained in at a minimum. Terminals shall be suitable for and mounted on a standard DIN EN 50022 mounting rail. Acceptable models and manufacturers are as follows:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Weidmuller	SAKS Series	
Entrelec	MB10/12 Series	
Phoenix	UK5 Series	

1) All of the above are with accessories as required for a complete assembly.

- e. Component Holder Terminal: Terminals shall be arranged for mounting on standard DIN mounting rail and shall be set up to allow a discrete electronic

component such as a load resistor or a trimmer pot to be mounted between the entering and leaving connection points. Jumpering shall be provided as required to interconnect to sliding link terminals if required by the application. Acceptable manufacturers and models are as follows:

<u>MANUFACTURER</u>	<u>MODEL</u>	<u>COMMENTS</u>
Curtis	CS Series	

1) With accessories as required for a complete assembly. Use for components with 14 and 16 pin DIP configurations.

Phoenix	UK4-TG/ST-BE	
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2) With accessories as required for a complete assembly. Use for 2 and 4 lead components.

- f. Feed Through Terminal Blocks: Feed through terminal blocks shall be compatible with the special purpose DIN rail system. Terminals shall be clamp type terminals suitable for solid or stranded wire from #18 AWG to #12 AWG (minimum range). Terminals shall be rated for the voltage and current at which they are applied and shall be provided with all necessary end caps, separators, etc., required for a complete installation.
- g. Grounding Type Terminal: Terminals shall be color coded green and yellow and shall be compatible with the other specialty terminals specified above and shall mount on the same DIN rail system. Units shall be arranged so that the wiring connected to them is grounded to the enclosure via the mounting rail. Terminals shall be Phoenix USLKG, MSLKG, or equivalent as manufactured by Weidmuller or Entrelec. These terminals shall be provided for grounding cable shields at the points where the cables enter a control panel and terminate on the control panel terminal strip.
- h. Resistor Style Terminal Block: Terminals shall be arranged for mounting on a standard DIN mounting rail and shall be provided with the appropriate resistor value and tolerance either factory or field installed. Terminals shall consist of a two level block with the upper terminals bussed together and the lower terminals bussed together. A resistor of the appropriate value and tolerance as require by the application and/or as indicated on the drawings shall be installed between the upper and lower busses. The terminals shall be applied where it is desired to pass a current loop through a series load resistor to generate a voltage drop for use by a control system or an indicator. Terminals shall be Allen Bradley 1492-UW5R, 1492-H2RA, B, or C, Phoenix UDK4-DUR, or equivalent models by Weidmuller or Entrelec.

3.8 ENCLOSURES - GENERAL

- A. Enclosures shall conform to the requirements of NEMA for the type specified. Finish color shall be the manufacturer's standard, unless otherwise indicated. Damaged surfaces shall be repaired and refinished using original type finish. Enclosures installed indoors shall be NEMA 1 or as specified for special applications. All enclosures shall be lockable.

3.9 NAMEPLATES

- A. Laminated plastic nameplates shall be provided for all I/O devices furnished. Each nameplate shall identify the function, such as "mixed air controller" or supply air temperature sensor." Laminated plastic shall be 0.125 inch thick, white with black center core. Nameplates shall be a minimum of 1 inch by 3 inches, with a minimum 0.25 inch high engraved block lettering. Nameplates for devices smaller than 1 inch by 3 inches shall be attached by a nonferrous metal chain. All other nameplates shall be attached to the device. The name of the I/O device, as referenced in software, shall be placed on the nameplate.
- B. Brass tags shall be minimum of 18 gauge polished brass, 1-1/2 inch diameter. Each tag shall include 0.25 inch high stamped black filled letters. Seton Type 250 BL or approved equal.

3.10 APPARATUS CONTROL PANELS

- A. All electrical, electronic or pneumatic equipment including DCPs, DTCs and UCPs shall be installed in suitable panels or enclosures to protect the equipment from environment, dirt, rain, vandalism, and accidental damage.
- B. Prewired apparatus control panels (ACPs) shall be provided for each HVAC unit and each system by the DDC System Supplier. ACPs shall include all electronic control chassis, relays, switches, transformers, time clocks, interval timers, pilot lights, setpoint adjustments, and temperature indication meters. All controls requiring adjustment shall be located in ACPs. The remote setting of the mixed air temperature and discharge temperature, regardless of whether by natural or mechanical cooling and the outdoor changeover shall be adjustable through a gradual switch at the face of the ACP.
- C. Each ACP shall be provided with an isolation valve to disconnect the ACP from its main instrument air supply and a disconnect switch to isolate the line side of all electric circuits within the ACP.
- D. The ACPs shall be fully enclosed cabinets, all-steel construction and shall meet the NEMA requirements for the location installed. All ACPs shall have hinged doors with a locking latch. ACP enclosures shall be NEMA 1 for indoor application. ACP enclosure for outdoor application shall be NEMA 4 or NEMA 3. ACP enclosures for the parking garage, dishwash room, and loading dock (indoor applications) shall be NEMA 4x (stainless steel or fiberglass).
- E. All ACP locks shall be keyed alike. A means of storing control system instructions and drawings shall be provided inside cabinet for future reference. Cabinet and door shall be finished with two (2) coats of paint.
- F. Instrumentation and control (I&C) diagrams for ACPs other than DCPs, DTCs and UCPs shall be provided. Drawings shall show complete I&C diagrams for all equipment furnished and shall be posted in the control panel. Drawings shall be furnished in permanently sealed laminated plastic. Condensed operating instructions explaining preventative maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system manually shall be prepared in typed form, laminated as specified for the I&C diagrams and posted beside the diagrams. Proposed diagrams, instructions, and other sheets shall be submitted and approved by the Architect/Engineer prior to posting. The instructions shall be posted before operation verification of the systems begins. Provide a mylar reproducible of each I&C diagram in addition to the posted laminated copy.

- G. In DCPs and DTCs, a nameplate shall be provided inside the enclosure indicating the DDC System Supplier's name, project number, year built, panel number, serial number (if applicable) and all applicable field wiring and connection drawing numbers.
- H. All ACPs shall be provided with laminated nameplates located on the exterior of the panel.

3.11 FLOW DIRECTION

- A. Flow direction shall be upward while drying. Any liquid water present in the inlet air is collected at the bottom of the tower, preventing bed contamination's. Purge flow is downward to maintain driest desiccant on top of tower and prevent bed movement during tower depressurization

3.12 ELECTRIC MOTORS

- A. All motors shall be designed for 208 or 460 volt, 3 phase, 60 Hz, alternating current with open drip-proof motor enclosures.
- B. All motors shall be built in accordance with the latest NEMA and IEEE standards. Motors 1 HP and larger shall have a guaranteed minimum full-load efficiency not less than tabulated herein as determined by the NEMA Standard MG1-12.53a, based on dynamometer testing per IEEE Standard 112, Test Method B, and labeled in accordance with NEMA 1-12.53b.

<u>Horsepower</u>	<u>Guaranteed Minimum Full Load Efficiency</u>
1 through 2	81.5
3 and 5	86.5
7-1/2 and 10	88.5
15 and 20	90.2
25 and over	91.7

- C. All motors shall be rated for continuous duty at full load at 40°F ambient temperature. Motors shall operate without undue noise. Any motor or control device which, in the opinion of the Architect/Engineer, is objectionable, shall be replaced by the Contractor. Lubricating devices shall be located so as to be easily accessible.
- D. Motors shall be manufactured by General Electric, Marathon Electric, Baldor, Lincoln, Reliance Electric or approved equal. Motors manufactured by U.S. Motors shall not be accepted.

3.13 COMBINATION STARTERS

- A. Standard magnetic starters shall be magnetic, motor circuit protector type with current limiter attachment, across-the-line full voltage nonreversing, 3 pole, 460 or 200 volt units as required; with ambient compensated three bimetallic thermal overall relays; with heaters; 120 volt control circuit transformer with one leg fused and the other leg grounded; auxiliary contact, switches and devices as required. Starters shall have on/off/auto switches on the face. Provide "run" and "stop" indicator lights on all starters. Enclosures shall be NEMA 1 type. Coordinate all starter sizes with equipment.
 - 1. Starters shall be rated for 65,000 symmetrical amperes available fault current. The starter manufacturer shall provide a current limiting module for each starter if required for the interrupting symmetrical amperes capacity. The DDC System Supplier shall provide the Owner with two (2) spare current limiter modules when current limiting modules are required for each size of starter provided for this project.

- B. Combination starters shall be as manufactured by Westinghouse, Square D, General Electric, Allen Bradley, Powell, or Eaton/Cutler Hammer.

END OF PART 3

PART 4 - SYSTEM SOFTWARE

4.1 GENERAL SYSTEM SOFTWARE REQUIREMENTS

- A. This part of the specification defines the minimum software requirements for the computer-based Direct Digital Control (DDC) System.
- B. The general system software is for DCPs and for Operator's Consoles.
- C. The software covered under this part of the specification includes DCP general software, Operator's Console software, general HVAC calculation software programs, general HVAC application programs and graphics.
- D. Custom software is covered in Part 5 of these specifications under HVAC Control Sequences. Control Sequences for specific packages are covered in other parts for individual packages.
- E. Communication Software for interfacing between the BAS System and The Laboratory system shall be fully BACnet compatible at the time of installation per Conformance Class 5 (as defined by the ANSI/ASHREA Standard 135-1995). Communication shall be capable via the Building TCP/IP Network.
- F. Interoperability Requirements for interfacing into all third party systems both existing and new.
 - 1. Third Party systems included but are not limited to:
 - a. Fire Alarm System via a serial BACnet interface to perform necessary sequences on drawings and within specifications. Coordinate with Division 26.
 - b. Electrical Metering (shall be part of contract except for providing the power monitor)
 - c. Variable Speed Drives (shall be part of this contract)
 - d. All other systems shown on drawings requiring serial interfaces.
 - 2. The interface will be a seamless integration of all system points from the ATC to the campus EMS.
 - 3. The interface will allow monitoring, reporting, alarming, and control of all system points.
 - 4. Graphical user interface screens must be developed using these points.
 - 5. The ATC vendor must provide any and all information, labor, programming and testing (i.e., points list, addresses, etc.) required to integrate the existing campus system.
 - 6. The ATC vendor must provide all software and/or equipment required to connect into their system.
 - 7. The University will provide the IP addresses and the range of the "BACnet Instance Numbers" for all systems.
 - 8. All data shall be viewable from work consoles provided as well as other campus locations.
 - 9. All data will be viewed in same format and function across all existing and new facilities.
 - 10. Communication
 - a. All control products provided for this project shall comprise a BACnet internetwork. Communication involving control components (i.e., all types of controllers and operator interfaces) shall conform to ASHRAE Standard 135-1995 or latest addition, BACnet, Conformance Class 5 as a minimum.

- b. Communication services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
 - 1. Connection of an operator interface device to any supervisory controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the campus network. Data, status information, etc. for all controllers shall be available for viewing and editing from any one supervisory controller on the internetwork.
 - 2. All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communication services to perform internetwork value passing.

G. System Functions For Interoperability

- 1. Regardless of the method selected to achieve interoperability, the DDC system should be expected to perform five basic tasks. These are:
 - a. Data Exchange: The exchange of data between two devices (e.g., PC workstations, building controllers, custom application controllers, or application specific controllers) is the most basic of interoperable functions. This function allows for the viewing (or reading) of data as well as making changes (or writing) of the data. For example:
 - 1. A building controller has a temperature sensor that measures the outdoor air temperature. This is modeled as an analog input object. If we wanted to view the outdoor air temperature we could use a PC workstation and ask for (or read) the present value of the analog input named "outdoor air temperature.
 - 2. In the same manner, we can change setpoints (write) to the values of analog and binary output objects and value objects. These basic functions can be used to share setpoints between controllers, provide data for graphics on a PC workstation, command the lights to come on, or sample data in a trend.
 - b. Alarms and Events: This function provides the operator with notification of non-normal conditions. A controller that has determined that an event has occurred is able to send an alarm message to a predetermined location. For Example:
 - 1. A program that periodically compares the space temperature to a user-entered alarm limit in the building controller detects that the space temperature is too high. When the temperature exceeds that limit, the building controller generates an alarm and sends it to the PC workstation. At that workstation, an operator reads the alarm and acknowledges it.
 - c. Schedules: This set of functions allows for the editing and creation of schedules on a PC workstation that will be executed in a controller. For example:
 - 1. The operator wants to change the stop time of the fan in the auditorium from 6:00 P.M. to 9:00 P.M. Using the scheduling function, the operator is able to

load the schedule from the controller, change the stop time, and have the modified schedule at the controller.

- d. Trends: The ability to sample, store and read trends is a valuable function. Trending is a tool for collecting data on system performance and energy usage. While trends are typically stored for archival purposes on a PC workstation, there are a number of reasons to sample them in a controller. This will reduce network traffic and also will allow for sampling of data if a PC is not continually connected to the controller.
 - e. Network Management: This final interoperability function provides the ability to manage the devices on the network. It includes tasks such as monitoring for a loss of communication and coordinating the time-settings of the clocks in each controller.
- H. As a minimum the DDC contractor will be required to provide the following points in BACnet Conformance Class 5 format with all associated Bacnet services to the Ethernet LAN connection.
- 1. Analog Inputs
 - 2. Analog Outputs
 - 3. Analog Values
 - a. Setpoints
 - b. Limits
 - c. Alarm Limits
 - d. PID Tuning Constants
 - e. Runtimes
 - f. Time Delays
 - 4. Binary Inputs
 - 5. Binary Outputs
 - 6. Binary Values
 - a. Alarm States
 - b. Enable / Disable
 - c. Start / Stop
 - d. Schedule Status
 - e. Manual Commands

4.2 TYPICAL BIBB REQUIREMENTS FOR THIRD PARTY SYSTEMS

BIBB TYPE	BIBB TYPE	BACnet Service	Initiate	Execute
(Acronym)	(Verbose Description)			
NOTE: BACnet Interoperability Building Blocks (BIBBs) are collections of one or more BACnet services. The services are prescribed in terms of an 'A' and a 'B' device. Both of these devices are nodes on a BACnet inter-network. In most cases 'A' will act as the user of data (like a BAS Server) and the 'B' device will be the provider of this data (like a field control module or router).				
Data Sharing				
DS-RP-A	Data Sharing-ReadProperty-A	ReadProperty	X	
DS-RP-B	Data Sharing-ReadProperty-B	ReadProperty		X
DS-RPM-A	Data Sharing-ReadPropertyMultiple-A	ReadPropertyMultiple	X	
DS-RPM-B	Data Sharing-ReadPropertyMultiple-B	ReadPropertyMultiple		X

BIBB TYPE	BIBB TYPE	BACnet Service	Initiate	Execute
(Acronym)	(Verbose Description)			
DS-RPC-A	Data Sharing-ReadPropertyConditional-A	ReadPropertyConditional		
DS-RPC-B	Data Sharing-ReadPropertyConditional-B	ReadPropertyConditional		
DS-WP-A	Data Sharing-WriteProperty-A	WriteProperty	X	
DS-WP-B	Data Sharing-WriteProperty-B	WriteProperty		X
DS-WPM-A	Data Sharing-WritePropertyMultiple-A	WritePropertyMultiple	X	
DS-WPM-B	Data Sharing-WritePropertyMultiple-B	WritePropertyMultiple		X
DS-COV-A	Data Sharing-COV-A	SubscribeCOV		
		ConfirmedCOVNotification		
		UnconfirmedCOVNotification		
DS-COVU-A	Data Sharing-COV-Unsubscribed-A	UnconfirmedCOVNotification		X
DS-COVU-B	Data Sharing-COV-Unsubscribed-B	UnconfirmedCOVNotification	X	
Alarm & Event Management BIBB's				
AE-N-A	Alarm and Event-Notification-A	ConfirmedEventNotification		
		Unconfirmed EventNotification		
AE-N-B	Alarm and Event-Notification-B	ConfirmedEventNotification	X	
		Unconfirmed EventNotification	X	
AE-ACK-A	Alarm and Event-ACK-A	AcknowledgeAlarm	X	
AE-ACK-B	Alarm and Event-ACK-B	AcknowledgeAlarm		X
AE-ASUM-A	Alarm and Event-Summary-A	GetAlarmSummary		
AE-ASUM-B	Alarm and Event-Summary-B	GetAlarmSummary		X
AE-ESUM-A	Event-Summary-A	GetEnrollmentSummary		
AE-ESUM-B	Event-Summary-B	GetEnrollmentSummary		
SCHEDuling BIBB's				
SCHED-A	Scheduling – A			
	(must support DS-RP-A and DS-WP-A)			
SCHED-B	Scheduling – B			
	(must support DS-RP-B and DS-WP-B)			
	(must also have one calendar, schedule and command object)			
Trending BIBB's				
T-VMT-A	Trending – Viewing and Modifying Trends - A	ReadRange		
T-VMT-B	Trending – Viewing and Modifying Trends - B	ReadRange		X
T-ATR-A	Trending – Automated Trend Retrieval - A	ConfirmedEventNotification		
		ReadRange		
T-ATR-B	Trending – Automated Trend Retrieval - B	ConfirmedEventNotification		X
		ReadRange	X	
BIBB TYPE	BIBB TYPE	BACnet Service	Initiate	Execute
(Acronym)	(Verbose Description)			

BIBB TYPE	BIBB TYPE	BACnet Service	Initiate	Execute
(Acronym)	(Verbose Description)			
Device Management BIBB's				
DM-DDB-a	Device Management – Dynamic Device Binding – A	Who-Is	X	
		I-Am		X
DM-DDB-B	Device Management – Dynamic Device Binding – B	Who-Is		X
		I-Am	X	
DM-DOB-A	Device Management – Dynamic Object Binding – A	Who-Has		
		I-Have		
DM-DOB-B	Device Management - Dynamic Object Binding – B	Who-Has		X
		I-Have	X	
DM-DCC-A	Device Management – DeviceCommunicationControl – A	DeviceCommunicationControl		
DM-DCC-B	Device Management – DeviceCommunicationControl – B	DeviceCommunicationControl		X
DM-PT-A	Device Management – PrivateTransfer – A	ConfirmedPrivateTransfer		
		UnconfirmedPrivateTransfer		
DM-PT-B	Device Management – PrivateTransfer - B	ConfirmedPrivateTransfer		
		UnconfirmedPrivateTransfer		
DM-TM-A	Device Management – Text Message – A	ConfirmedTestMessage		
		UnconfirmedTextMessage		
DM-TM-B	Device Management – Text Message – B	ConfirmedTextMessage		
		UnconfirmedTextMessage		
DM-TS-A	Device Management – TimeSynchronization -A	TimeSynchronization	X	
DM-TS-B	Device Management – TimeSynchronization - B	TimeSynchronization		
DM-UTC-A	Device Management – UTCTimeSynchronization - A	UTCTimeSynchronization		X
DM-UTC-B	Device Management – UTCTimeSynchronization – B	UTCTimeSynchronization		
DM-RD-A	Device Management – ReinitializeDevice – A	ReinitializeDevice		
DM-RD-B	Device Management – ReinitializeDevice – B	ReinitializeDevice		
DM-BR-A	Device Management – Backup and Restore – A	AtomicReadFile		
		AtomicWriteFile		
DM-BR-B	Device Management –Backup and Restore –B	AtomicReadFile		
		AtomicWriteFile		

BIBB TYPE	BIBB TYPE	BACnet Service	Initiate	Execute
(Acronym)	(Verbose Description)			
DM-LM-A	Device Management – List Manipulation – A	AddListElement		
		RemoveListElement		
DM-LM-B	Device Management – List Manipulation – B	AddListElement		
		RemoveListElement		
DM-OCD-A	Device Management – Object Creation and Deletion – A	CreateObject		
		DeleteObject		
DM-OCD-B	Device Management – Object Creation and Deletion – B	CreateObject		
		DeleteObject		
Network Management BIBB's		BACnet Network Layer Message		
NM-CE-A	Network Management – Connection Establishment – A	Establish-Connection-To-Network		
		Disconnect-Connection-To-Network		
NM-CE-B	Network Management – Connection Establishment – B	Establish-Connection-To-Network		
		Disconnect-Connection-To-Network		
NM-RC-A	Network Management – Router Configuration – A	Who-Is-Router-To-Network	X	
		I-Am-Router-To-Network		X
		I-Could-Be-Router-To-Network		X
		Initialize-Routing-Table	X	
		Initialize-Routing-Table-Ack		X
Virtual Terminal BIBB's		BACnet Service		
VT-A	Virtual Terminal – A	VT-Open		
		VT-Close		
		VT-Data		
VT-B	Virtual Terminal – B	VT-Open		
		VT-Close		
		VT-Data		

4.3 DCP GENERAL SOFTWARE

A. DCP Functions

1. The DDC System Supplier shall provide the necessary software to accomplish the following functions, fully implemented and operational, as a part of the DCP.
 - a. Scanning of inputs.
 - b. Control of outputs.
 - c. Respond to all Operator's commands, whether at the local DCP or at a remotely located DCP.

- d. Maintain real time communication with all DCPs in the system.
 - e. DCP diagnostics.
 - f. Run all applications software and control sequences.
 - g. Perform all mathematical functions and operations necessary for DDC system operation as specified.
 - h. Commonly used functions and operations shall be assigned to function keys in order to facilitate system operator interface.
 - i. Access to other system nodes shall be transparent to the user.
 - j. The operator shall be able to perform the following functions:
 1. Automatically control the status of equipment, devices and systems and/or the value of their operating parameters.
 2. Display the status of equipment, devices, and systems and/or the value of their operating parameters.
 3. Modify operating parameters and status.
 4. Automatically trigger audible and visual indications of alarm(s).
 5. Investigate and acknowledge alarm conditions.
 6. Provide means to change, on-line, the control strategies or operational sequences.
2. Operating System: The DCP shall contain an operating system that controls and schedules DCP activities in real time. The DCP shall maintain a current point status of all points connected to that DCP. The execution of DCP application programs shall utilize the current status. The operating system shall include a real time clock function that maintains the seconds, minutes, hours, date and month, including day of the week. The operating system shall provide communication to allow the loading of software and data files between the DCP and all management consoles in the system.
 3. Monitoring and Control: Each command shall be executed by the DCP only after all constraint checks have been passed. As a minimum, each point shall have unique read and write access levels associated with them. Each logical point grouping shall be associated with a particular security zone used to allow or disallow access to logical point groupings. Each individual point shall be capable of being selectively overridden. Each analog point shall have high and low limits which constrain operator entry of values.
 4. DCP Self-Test Diagnostics: Each DCP shall have self-test diagnostic routines implemented in firmware. The tests shall include routines that exercise memory.
 5. DCP Performance Specifications: All Proportional Integral Derivative (PID) loops on the DCP shall execute periodically at a period not greater than 1.5 seconds. All PID constants shall be adjusted according to actual run time. The DCP shall provide user adjustable scan and control times in increments of not greater than 0.5 seconds. Each partition of the control algorithm on a DCP shall have its own pre-defined period of execution. This execution rate shall be user-modifiable on-line. Free running control algorithms are not acceptable.
 6. DCP Start-up: The DCP shall have start-up software that causes automatic commencement of operation without human intervention. The start-up software shall initiate operation of self-test diagnostic routines. If the data base and applications software are not resident, the DCP shall attempt to communicate with any of the management consoles in the system to rectify the situation. If the real time cannot be read, the DCP shall attempt to communicate with other panels in the networked system to obtain the current real time.
 7. DCP Operational Mode: The DCP shall perform all specified functions and application programs using data obtained from the DE and based upon the DCP real time clock function. All information required for operation, as specified for each day of the week and for a holiday schedule, shall be stored in the DCP data base and shall include inputs for operating for each mechanical system controlled by each DCP. The DCP shall answer

requests for data communications from all other DCPs in the network and from all management consoles in the network, including the following:

- a. Execution of local (on this DCP) and remote (on any other DCP) operator initiated commands.
- b. Modification of control algorithm parameters which reside on the local DCP or any remote DCP.
- c. Downloading of a database from any management console in the system.
- d. Uploading of a DCP resident database to any management console in the system.
- e. Updating of the real time clock from any other DCP in the system.
- f. Updating of the user definition tables from any other DCP in the system.
- g. Capability to process alarms, both local alarms and alarms which are generated from any grouping of other DCPs which are on-line.
- h. The DDC control software shall be based upon pre-defined software function blocks. These software function blocks shall be similar to process control hardware components.
- i. The system shall provide overlay capabilities for bumpless multi-mode of alternate algorithm operations.
- j. All setpoints, constants, and control response shall be completely field adjustable through the entire design ranges.
- k. Programming shall permit manual input values to be entered at any level necessary for operational field testing purposes.
- l. An operator security system shall be provided that is identical in function to that of the system management console to prevent unauthorized access.
- m. All control loops shall contain proportional, integral, and derivative modes of actions as defined by SAMA Standard PMC 20-1, 1973. The modes of control shall be completely field adjustable.
- n. The control panel shall be capable of performing the following control algorithms or combinations thereof: PID control with bumpless transfer; high/low signal selection; comparison of one or more signals against a standard or each other; square root; polynomial equations; analog signal delay; totalization of two or more signals; track and hold. All algorithms shall have an end-to-end minimum accuracy, regardless of the number of functions used, of 0.25 percent as defined by SAMA Standard PMC 20-1, 1973.
- o. All analog input and output points shall be adjustable for high limit, low limit, high alarm, and low alarm.
- p. An adjustable input response filter shall be provided for all analog input points to eliminate incoming process, sensor and/or transmission noise.
- q. Separately adjustable on and off delay times shall be provided for all binary input and output points.
- r. The system, upon restoration of power following a power failure, shall be capable of selectively initializing the database before resuming its normal program. The system shall insure that restored critical points are in a safe position before continuing operating without disturbing previous operator parameters.
- s. All outputs, through an internal segmented equation or polynomial curve generator, shall linearize all final control devices, e.g., valves, dampers, etc., to provide an output liner with process characteristics. This will make system sensitivity independent of device position. The device characteristics data necessary shall be obtained through published manufacturer's test data or actual field measurement. This data, along with the polynomial coefficients being used, shall be submitted to the Architect for his approval.
- t. All binary outputs shall be provided with a hardware power-up initialization to take place before software initialization which shall insure that all of the binary contacts are in the open position upon power application. This will prevent these outputs from initializing in a random state.

- u. The DCP shall be expandable to 60 PID loops with a scan rate not greater than 1 second.
 - v. Each DCP shall be capable of handling up to 200 points.
 - w. System scan rates shall be variable down to 0.5 seconds for added flexibility.
 - x. System I/O scanning shall be high speed with update times not to exceed 400 milli-seconds.
8. DCP Failure Mode: Upon detection of a self-diagnosed error, the DCP shall attempt to restart operations if possible. If this is not possible, the DCP shall cease operations. The I/O subsystem, upon recognizing loss of communications with the DCP, shall go to a preselected failure mode.
9. DCP Commands: The DCP shall accept English language commands for defining and selecting points, parameters, and all other functions associated with operation of the DCP.
10. Command Input: DCP commands shall be full English language words and acronyms selected to allow operators to use the system without extensive training or data processing backgrounds. The DCP shall prompt the operator in full English words and acronyms for all required information identifying acceptable command formats. The operator's response shall be an English word, phrase, or acronym including parameters where required.
11. Command Input Errors: The DCP shall supervise operator inputs to ensure they are correct for proper execution. Operator input assistance shall be provided whenever a command cannot be executed because of operator input errors.
- a. Conditions for which operator error assist messages shall be generated include, but are not limited to:
 - 1. The command used is incorrect or incomplete.
 - 2. The operator is restricted from using that command.
 - 3. The command addresses a point which is disabled or out of service.
 - 4. The command addresses a point which does not exist.
 - 5. The command would violate constraints.
 - 6. A log of all operator commands and log-ons, successful or otherwise, shall be maintained at the operator's console database.
12. Operator's Commands: Operator's commands shall be provided as part of the DCP software for performing the following tasks:
- a. Display any digital or analog point or grouping of points connected to any DCP in the entire networked system.
 - b. Start-up and shutdown selected systems or devices.
 - c. Modify point attributes on the local or any remote DCP.
 - d. Modify point values on the local or any remote DCP.
 - e. Modify time and event scheduling on the local or any remote DCP.
 - f. Adjust setpoints on the local or any remote DCP.
 - g. Select manual or automatic control modes on the local or any remote DCP.
 - h. Provide alarm indication and processing for the local DCP and any grouping of remote DCPs.
 - i. Allow time of day modification from any DCP in the networked system.
 - j. Provide time of day synchronization between the local and all other DCPs in the networked system.
 - k. Allow modification of user access tables from any DCP in the networked system.
 - l. Provide user access table consistency among all DCPs in the networked system.

- m. Display a menu of operator's commands and a description of each command in response to operator entered help requests.
 - n. Status of alarms and other information from remote sites.
13. Unique addressing for identification shall be provided for each point in the entire networked system. The unique name for the point should include the DCP the point is located on, the device the point is located on, and a name which is related to the individual sensor or the control device's name. A minimum of six alphanumeric characters shall be allowed for each portion of the point address for a total minimum of eighteen alphanumeric characters to uniquely describe any point in the networked system.
14. System Access Control: Access to data within the system shall be limited by three items; read level, write level, and security zone. There shall be a minimum of 127 read and write levels in the system and a minimum of 20 security zones definable in the system. Each user shall have a read level, write level, and list of security zones they may access when they enter the system. Any data access performed in the system must be verified against these security control items. This security must be maintained across the entire networked system, on both the local and all remote DCPs. The definition of security levels shall be arbitrarily assignable over the entire range of read and write levels. The definition of security areas shall be arbitrary across groupings of points and partitions of the control algorithm.
15. Calculated Point: This value shall be created by calculating it from any combination of digital and analog points, or other data. The result of the calculation will be an analog or digital point having all the properties of real points, including alarms, without the associated hardware. The calculated analog point shall have point identification in the same format as any other analog point. The calculated point shall be used in any program where the real value is not obtainable directly. Constants used in calculations shall be changeable on-line by the operator.
16. Analog Monitoring: The system shall measure and transmit, as specified, all analog values including calculated analog points. An analog change in value is defined as a change exceeding a preset differential value as specified. The record transmitted for each analog value shall include a readily identifiable flag which indicates the abnormal status of the value when it deviates from operator selectable upper and lower analog limits. All analog values shall be expressed in proper engineering unit with sign. An appropriate vocabulary of engineering units shall be provided to provide meaningful translation of binary states to descriptive terms (e.g., ON/OFF, TRUE/FALSE, etc.) and to meaningfully describe analog values (e.g., CFM, FPM, percent, etc.). Scaling Factors shall be provided to scale raw analog input and output counts into meaningful floating point values. The scale factor shall be a polynomial of not less than the 4th degree which can be used to determine range and span of the analog value as well as linearize non-linear end devices.
17. Analog Totalization: Any analog value point shall be totalizable. There shall be no limit on the number of analog values totalized. Each analog value totalized shall have its own totalization time period. At the end of the time period, the total shall be stored. Totalization shall then restart from zero for the next time period. The operator shall be able to set or reset each totalized value individually. The time period shall be modifiable on-line. The program shall keep track of the peak, minimum, and total value measured during the current period and for the previous period.
18. Energy Totalization: The system shall calculate the heat energy in Btu's (ton-hours or KWH), for each energy source consumed the mechanical systems specified, totalize the calculated Btu's, the instantaneous rate in Btu's per hour, and store totals in millions of Btu's (BTU E06). The Btu's calculated shall be totalized for an adjustable time period. The time period shall be defined uniquely for each Btu totalization. The time periods shall be able to be defined, modified, or deleted on-line.

19. Trending: Any analog and binary input, output, or calculated point may be trended. Each point trended shall have its own sample rate, with a minimum sample rate of not greater than one second to trend real-time data. The maximum sample period must be no less than 24 hours. The number of points in the trend shall be user-definable, and shall at least encompass the range from 64 points to 3,600 points (i.e., 60 minutes of trending sampling once a second) to allow for precise monitoring of selected analog points.
20. Summer-Winter Operation Monitoring: The system shall provide software to change the operating parameters, monitoring of alarm limits, and start-stop schedules for each mechanical system from summer to winter and vice versa. The software shall provide appropriate commands to applications programs to coordinate proper summer or winter operation.
21. DCP Data: Each DCP shall supervise the following alarm and event conditions and manage the communication of alarms and events to other DCPs and management consoles.
 - a. The system shall record the time and date of each occurrence of an analog point exceeding its high or low limits or of a binary point entering its abnormal state. The system shall record the time and date that the point returns to normal.
 - b. Any communication failure within the system and its subsequent restoration shall be recorded.
 - c. Any user changes made to points, parameters, etc. shall be recorded.
 - d. Any user changes made to the system clock which resides at each DCP shall be recorded.
 - e. Any valid or invalid operator sign-on and all operator sign-offs shall be recorded.
 - f. Record alarm conditions as communicated by the DDC system, monitoring system for electric switchgear and monitoring system from remote sites.
22. Report Formatting: All point values and alarm data may be shared across the network by any or all DCPs and management consoles. In addition, all trends in the system may be defined or retrieved by any or all management consoles in the system.
23. DCP Communications Software: Provide all communications software which allows each DCP to transparently access all point, alarm, and control data at all other DCPs in the system. The user at any DCP shall be able to access point and control data at all other DCPs in the system transparently. The communications software at the DCP shall also be capable of communicating with all management consoles in the system. The management consoles shall be capable of making requests to the DCPs including, but not limited to downloading of programs, uploading of programs, downloading of trend definitions, and uploading of trend data. The communications software used shall incorporate error detection, message retry, and packet sequencing in its software or hardware protocols.
24. Function Blocks Programming Modules: all standard operating software necessary to support the control functions described in the specification shall be provided. The DDC System Supplier shall provide as a minimum all software modules specified under this section. The system shall provide stand-alone operation. Interaction between the operators and the control system shall be through the use of a CRT English Language display. Computer programming knowledge shall not be required.
 - a. PID Control Module: This module shall take a measured variable and shall compare its value to its setpoint. The difference of these values is multiplied by a constant to produce a proportional term. An integral term is calculated and multiplied by the integral gain constant. The difference between the current measured value and the last measured value is multiplied by the derivative gain constant. These terms are used in an equation to produce an output control signal. (Example of application: this module can be used to operate a fan to maintain a constant static pressure.)

- b. Dual PID Control Module: this module shall operate as the PID control module, except it shall input two measured variables and a setpoint for each. Two control signal values shall be calculated and the higher of these two signals shall be selected as the output control signal. (Example of application: this module can be used to control a fan from both CFM and static pressure.)
- c. Logic Module: the logic function shall be defined by a Truth Table that lists all possible combination of states (on or off) of the four inputs. To specify the gate function, the desired output state shall be selected for each of the 16 input conditions. (Example of application: this module can be used to determine if there are any fans running.)
- d. Square Root Extraction Module: this module shall calculate the square root of its analog input and multiply this result by a constant. (Example of application: this module can be used to convert velocity pressure readings into CFM values.)
- e. Multiplier Module: this module shall input two analog values and output their products. (Example of application: this module can be used to calculate a percentage of a value.)
- f. Signal Comparator Module: this module shall output a binary signal dependent on the difference between two analog values. (Example of application: this module can be used to turn compressors on and off based on outdoor air temperature.)
- g. Signal Switching Module: this module shall output either of its two analog inputs based on its binary input. (Example of application: this module can be used to switch between setpoints for different modes of system operation.)
- h. Low Selector Module: this module shall output the lowest of its three input values. (Example of application: this module can be used to input the static pressure in a number of ducts and output the lowest one to a controller.)
- i. High Selector Module: this module shall output the highest of its three input values. (Example of application: this module can be used to input the static pressure in a number of ducts and output the highest one to a controller.)
- j. Binary Connect Module: this module shall connect one binary value to another point. (Example of application: this module can be used to output one binary value to a number of binary points.)
- k. Sum Module: this module shall multiply each of its inputs (3 max) by a unique gain constant and output the sum of these terms. (Example of application: this module can be used to calculate the average of three values.)
- l. Sum N Module: this module shall output the sum of its inputs. (Example of application: this module can be used to add CFM values to produce a total system CFM value.)
- m. Track and Hold Module: this module shall output its input value while its binary input is in the "on" state. The output retains the value once the binary input switches to "off" and will not change until the binary input goes to "on" again. (Example of application: this module can be used to allow many analog inputs to be transmitted to one data line.)
- n. Analog Connected Module: this module shall connect one analog value to another analog point. (Example of application: this module can be used to output one analog value to many analog points.)
- o. Timer Module: this module shall switch a binary output to match its binary input after an adjustable on or off time delay. (Example of application: this module can be used to provide time delays in the starting and stopping of chillers.)
- p. Ramp Module: this module shall ramp its output up or down from its initial value, depending on its binary input. The ramping function shall occur at adjustable up and down rates. (Example of application: this module can be used to slowly add the capacity of a second fan to a system.)

4.4 OPERATOR'S CONSOLE SOFTWARE

- A. The Operator's Console software shall support all specified functions. The standard system software supplied by the computer system manufacturer shall not be modified in any way that would preclude the purchase of a standard maintenance and service contract from the computer manufacturer.
- B. Each Operator's Console shall be provided with the following general software:
1. Bootstrap Program: The software shall include a bootstrap program sufficient to initiate operation of the Operator's Console using only procedures specified by the computer manufacturer.
 2. Disk Operating System: A publicly available and supported disk operating system equal to the latest version of Microsoft Disk Operating System (MS-DOS) and Windows operating system shall be utilized, featuring:
 - a. Program control functions including program loading, execution, and termination.
 - b. Error detection and recovery.
 - c. Keyboard and display I-O control.
 - d. Serial and parallel I-O control.
 - e. File management including creation and deletion of files, searching, sequential and random file access, and maintenance of file directories and subdirectories.
 - f. Disk/tape management including drive selection, partitioning, space allocation and recovery, write verification, and a copy routine to transfer information between any two devices.
 - g. Editor software to accomplish input, modification, display, listing, and storage onto the disk files of the source languages.
 - h. Diagnostic programs to check the status of the Operator's Console on its screen.
 - i. Maintenance of current date and time.
 3. Operator's Console Commands: The operator's console commands shall provide a means for entry of control and monitoring commands, and for retrieval of DDC System information. The operator's commands shall perform tasks including:
 - a. Request and terminate dial-up communications with any DCP.
 - b. Perform all tasks provided by the DCP and specified under "DCP Operator's Commands". A single command entered by the operator shall be issued by the DCP to the device within ten seconds, provided communication with the DCP has been established prior to command issuance.
 - c. Update any DCP time base from the Operator's Console time base.
 - d. Request CRT display or printed reports, including a complete status listing for any point or all points in any DCP, all specified trend data, and the intrusion alarm log for any DCP. Point data and reports as specified shall be arranged logically for CRT display.
 4. Printer Output: Formats for printed data shall be similar to and consistent with those used in CRT alphanumeric data displays. English language descriptions printed shall be identical to those presented on the operator's console CRT.
- C. Operator's Console and DCP Data Exchange Requirements
1. Data exchange shall be provided between the Operator's Console and the DCP's including:
 - a. Transmission from the Operator's Console to the DCP/RAM resident software, operating parameters and constraints, and operator commands.

- b. Transmission from the DCP to the Operator's Console of all data, including parameters of the DE, constraints, and RAM resident software.
2. DCP programs and parameters shall be capable of being transmitted from the Operator's Console to the DCP, including all changes to DCP parameters. DCP parameter changes shall be capable of being performed with the DCP on-line.

4.5 GENERAL HVAC CALCULATION SOFTWARE

- A. General: The following paragraphs describe general calculation software which will result in "calculated points". Calculated points shall be provided as called for on the I-O Summary Tables.
- B. Run Time Calculation: This calculation shall create software points for run time based on actual run time and speed as necessary. The run time shall be measured in increments of 1,000 hours (hrs E03). Scaling factors may be applied for systems with variable speed drives or two-speed drives. Refer to maintenance alarm in Paragraph 4.5, Subparagraph Q for further requirements.
- C. Flow Calculation: This calculation shall create software points for flow (CFM, #/hr., GPM, etc.) based on differential pressure, pressure, and temperature as necessary. This calculation shall include a method of inputting a characteristic equation for the specific flow measuring device such as a pitot tube or orifice meter.
- D. Energy Flow Calculation: This calculation shall create software points for energy flow (MBTUH or tons) based on fluid or gas flow (CFM, #/hr., GPM) and differential temperature (ΔT). It shall also create software points for energy flow (KW) based on a pulsed input.
- E. Utility Consumption Calculation: This calculation shall create software points for total energy consumed (Btu E09, ton-hours E06, KWH E03) through integration of the energy flow data. It shall also totalize other utility usages (natural gas - CuFt E06, Steam - pounds E06, water - gallons E09, medical gases - CuFt E06). In addition, the calculation shall calculate heating and cooling consumption weather data, i.e., heating-degree days based on outdoor dry bulb temperature and 65°F, cooling-degree days based on outdoor wet bulb temperature and 62°F w.b. Utility usages shall be stored on a monthly and an annualized basis. Available data shall include month-to-date, year-to-date, previous 24 months, previous 10 years. Each monthly utility consumption data collection system shall be field programmable to start and end on the same dates as the utility company starts and ends its billing period. The calculation shall also have an input for up to four unit costs and usage levels. These unit costs shall be manually input and shall produce a monthly billing.
- F. Utility Demand Calculation: This calculation shall create software points for all maximum, minimum, and average utility demands. Based on flow data, energy consumption data, or utility consumption data (CFM, KBTUH, tons, pounds per hour, CFH, GPM, KW, etc.). The data shall be collected on a monthly basis which coincides with the utilities' normal billing period. The peak and minimum utilities shall be recorded based on the highest average usage over a 15-minute period. The average demand shall be calculated using the total monthly consumption divided by the time in the monthly billing period. Available data shall include month-to-date, year-to-date, previous 24 months. Each data point shall be accompanied by a time of occurrence (end time), date, outdoor dry bulb temperature, and outdoor wet bulb temperature (as applicable). The calculation shall also have an input for up to four unit costs and usage levels. These unit costs shall be manually input and shall produce a monthly billing.

- G. Efficiency Calculation: This calculation shall create software points for efficiency based on an equipment device's total output and its major controlling input. For example, for electric chillers the calculation would measure KW/ton; for absorption chillers the calculation would measure pounds of steam/ton-hour, for boilers the calculation would measure gross Btu's input/net Btu's output.

4.6 DCP APPLICATIONS SOFTWARE

- A. General: Provide the applications programs noted on the control drawings.
- B. Control Sequences: All control sequences shall be modifiable by the operator. It shall be possible to perform parameter value changes while the system is on-line and running. To provide for minimum impact in the system caused by changing a sequence while it is running, substantial changes to the control sequences may only be made at the main operator's console. These changes may then be downloaded to any DCP for execution. Each DCP shall be supplied with a minimum of 15 percent free CPU capacity. The event that meeting this criteria would cause the splitting of critical control sequences, the next nearest DCP may contain the additional spare capacity for its neighbor.
- C. Alarms
1. Alarms will be programmed in three levels minimum. These will differentiate between critical, abnormal, and maintenance.
 2. Critical alarms would include equipment failures, freezestats, smoke, etc. and would demand immediate attention by the highest level of the maintenance staff. These alarms would be printed immediately and would sound audible alarms as provided.
 3. For critical alarms, the following capability shall be provided. If a critical alarm is not acknowledged in a predetermined Supplier and the DDC System Installer. Refer to H8.03 Exhibit halls sequence varies.
 4. Exhaust fans in Engineered Fire Control Systems will normally not be affected by evidence of fire. They will continue to run or (operator adjustable) time, then the Operator's Console shall automatically call a user defined phone number for PUH paging and send an alarm on the operator's pager. This is necessary to ensure that the operator does not miss a critical alarm when he is away for short periods of time. Additionally, the alarm information may be displayed at the Security Station, other Operator Consoles, or communicated to the supervisor over the phone.
 5. Abnormal alarm would include high and low temperature readings, acknowledged critical alarms, standby pump in operation, equipment being out of service for maintenance. These alarms would demand immediate attention by the next normal day-shift maintenance staff. These alarms would be displayed immediately at their assigned alarm point designation.
 6. Maintenance alarms would include any other alarm such as dirty filters, run-time alarms for preprogrammed maintenance, etc. Run time alarms shall be set up on each device shown in the I/O summary tables. These alarms shall be disk filed in ASCII format with respect to date, time, system, point name and chronological event number. In addition, the date and time of the subsequent service work shall also be disk filed. These alarms would be printed only when requested.
 7. All alarms shall be user-programmable to any level and to any alarm point destination (Operator Consoles). Alarm point destinations may be programmed to change automatically by the time of day, day of week, etc. All alarm point attributes high and low levels shall also be user-programmable.
 8. In case of alarms not being acknowledged, the DDC System shall call up to three user-designed alpha pagers via STMP and relay an appropriate alarm message This message shall be repeated a user-defined number of times.

4.7 GRAPHICS SOFTWARE

A. Operational Color Graphics

1. The operator shall be able to perform the following operations by using a mouse-driven user interface to "point and click."
 - a. Examine process variables and operating conditions.
 - b. Adjust setpoints and other process parameters.
 - c. Collect, report and plot trended data.
 - d. Define and augment control strategies.
 - e. Upload and download control data and algorithms.
2. Building/Creating Color Graphics
 - a. The operator shall be able to create and modify graphic schematics, building floor plans and other facilities oriented displays. Color Graphics displays shall be created by using the operator's keyboard or mouse or any combination thereof. The minimum capabilities shall include:
 1. Create and save symbols.
 2. Create and save pages.
 3. Group and ungroup symbols.
 4. Modify an existing symbol.
 5. Modify an existing graphic page.
 6. Rotate and mirror a symbol.
 7. Place a symbol on a page.
 8. Place analog dynamic data in decimal format on a page.
 9. Place binary dynamic data using state descriptors on a page.
 10. Create motion through the use of gif, jpeg or bmp files
 11. Place test mode indication on a page.
 12. Place manual mode indication on a page.
 13. Place links using a fixed symbol or flyover on a page.
 - a. Links to other graphics.
 - b. Links to web sites.
 - c. Links to notes.
 - d. Links to time schedules.
 14. Assign a background color.
 15. Assign a foreground color.
 16. Place alarm indicators on a page.
 17. Change a symbol color as a function of an analog variable.
 18. Change a symbol color as a function of a binary state.
 19. Change symbols as a function of a binary state.

20. All symbols used by the contractor in the creation of graphic pages shall be saved to a library file for use by the owner.
 - b. The-graphics package shall contain a standard symbol reference where an operator can select already created objects such as air handlers, fans, pumps, etc., and place them in desired locations while creating graphic diagrams.
 - c. It shall be possible to place live updating field point data and calculated data anywhere as desired in the diagram.
 - d. Color graphics shall be user friendly and shall include a menu which includes standard symbols for constructing "new" color graphics or for modifying existing color graphics. All symbols shall include required data fields which can be "snapped" to for control by the mouse. These symbols shall be readily able to be enlarged or reduced to fit the final graphics. All symbols shall be user programmable for color based on its operation status. Refer to the control drawings for all points/components/systems to be on the graphics.
3. The graphics package shall also include a menu for creating graphics from "scratch." This portion of the graphics package would be created similar to an AutoCadd drawing and the final drawing would include all attributes for mouse control as required previously in this paragraph.
4. The color graphics shall use AutoCadd type floor plans for the facility.
5. Graphic points shall be bound on line without having to assign any logical point types.

4.8 Web Server Software

- A. This software shall enable operators to access the system from remote computers using only browser software. The software shall allow for a minimum of five (5) concurrent users. Once connected to the system the operators shall be able to execute the following tasks:
1. View dynamic data in a real time environment in both point list format and in a graphical page format.
 2. View and acknowledge alarms.
 3. Adjust time schedule parameters.
 4. View historical trend data in table and graph formats.
 5. View dynamic real time trends in graph format.
 6. Run established reports.
 7. Manually adjust application parameters.
 8. Manually override physical inputs (sensor values) and force a specific value as an input to control logic.
 9. Manually override physical outputs (end devices) and force a specific value regardless of the command from the control logic.
- B. The Web Delivery System shall have the capability to expand to 25 concurrent web-client users looking at the same hardware environment subject to the purchase of additional software licenses.

END OF DDC PART 4

PART 5 - GENERAL SEQUENCES OF CONTROL

5.1 SCOPE

- A. This Section covers "General Sequences of Control" which are to be followed throughout the length of this contract.
- B. The control strategies on the control drawings shall be used in conjunction with the matrices for controller drawings herein for engineering the control systems and preparing the required control drawings.
- C. The control matrices and the sequence have been made to compliment each other. In addition, due to the nature of some controls, more or less hardware points may be necessary to accomplish the intent. The DDC System Supplier shall include all such hardware necessary to accomplish this task at no additional cost to the "unit costs". The DDC System Suppliers shall also treat the sequences and the matrices such that if a device is called for in one and not the other, it will be treated as if called for in both.

- D. Control of all HVAC equipment shall be through the DDC system unless each individual sequence specifies otherwise. If a particular sequence specifies pneumatic controls for certain HVAC equipment, pneumatic controls shall be provided for the HVAC equipment identified under that sequence only.
- E. In preparing the unit cost for the work, refer to Part 1 of this specification. Refer to paragraph 1.16 for other unit pricing requirements. The unit prices for these sequences are to include all valves, dampers, sensors, DCPs, DTCs, UCPs and other hardware required.
- F. When executing this work on this project, all Division 23 requirements for the project shall apply. In case of a discrepancy between the requirements of the project and this document, the most stringent requirement shall apply. If this happens, the matter shall at once be brought to the attention of the Architect/Engineer, the C.M., and the Owner.
- G. If significant changes are made to a control sequence for a future project, the control sequence nearest to the one desired shall be utilized. If significant changes in hardware are required, the same could be done for various control components from unit prices.
- H. The unit prices for the control sequences shall include the labor cost for the DDC System Supplier to interface with future project engineering and to provide detailed installation drawings that can be included in the future bid packages for obtaining installation prices.
- I. The control sequences given in this section will be used to price the additional work.
- J. The following Generic DDC Control Sequences are found at the end of this section

END OF PART 5

END OF SECTION 230900

SECTION 230999 - COMMISSIONING OF INTEGRATED AUTOMATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The purpose of this section is to specify responsibilities and participation in the commissioning process.
- B. Developing and witnessing the Commissioning process is the responsibility of the Commissioning Authority. Performing the Commissioning is primarily the responsibility of the Contractor, with support for start-up, testing, and commissioning testing the responsibility of Subcontractors. The commissioning process does not relieve the Contractor from participation in the process, or diminish the role and obligations to complete all portions of work in a satisfactory and fully operational manner.
 - 1. Work includes:
 - a. Testing and start-up of the equipment including completed control systems, point-to-point verification of all system inputs and outputs, calibration checks, and accurate system graphics
 - b. Provide qualified personnel for participation in commissioning tests, including seasonal testing required after the initial commissioning.
 - c. Provide training to the Commissioning Authority and Owner on basic operation and programming of the control system.
 - d. Fulfilling contract and warranty requirements by profiling equipment, software, software programming materials, and labor necessary to correct deficiencies found during the commissioning process.
 - e. Completion and endorsement of supplier's standard pre-functional test checklists to assure that the ATC equipment and systems are fully operational and ready for functional testing.
 - f. Providing operation and maintenance information and as-built drawings to the Commissioning Authority for review and verification prior to final distribution
 - g. Incorporate correct and final control sequence documentation on control drawings.
 - h. Providing training for the systems specified in this Division to the Owner, with coordination by the Commissioning Authority

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. All testing and start-up procedures and documentation requirements are specified within Divisions 1, 23, 26 and related portions of this project.
- B. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.
- C. Division 23 Section "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.
- D. Division 23 Section "TAB Commissioning" for commissioning process activities for Testing, Adjusting and Balancing.
- E. Division 26 Section "Commissioning of Electrical Systems" for commissioning process activities for electrical systems, assemblies, equipment, and components.

1.3 SUBMITTALS

- A. In addition to the stated requirements for operation and maintenance data, provide one copy of equipment technical literature, operation and maintenance literature, and shop drawings to the Commissioning Authority as soon as they are available. This requirement is for review of these documents prior to distribution of multiple copies for the Owner's final use.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide standard and specialized test equipment as necessary to test and start-up the mechanical equipment.
- B. Any proprietary test equipment required by the manufacturer shall be provided by the equipment manufacturer. Manufacturer shall provide the test equipment and assist the CA in the commissioning process
- C. This Contractor shall provide all equipment, software, and all test programming support as necessary to start up, calibrate, debug, and verify proper function of the control/facility management system. This equipment and software shall be provided for use by both the Contractor and the Commissioning Authority.
- D. Proprietary test equipment, including hardware, software, and specialized test instruments required by the manufacturer for system testing and commissioning whether specified or not, shall be provided.

PART 3 - EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

- A. Complete all phases of work so the system can be started, tested, balanced, and otherwise commissioned for beneficial use by the Owner. Contractor has primary start-up responsibilities with obligations to complete systems, including all sub-systems so they are functional. This includes the complete installation, checkout, and calibration of all sensor controlled device equipment, materials, wire, controls, software, etc., per the Contract Documents and related directives, clarifications and change orders.
- B. A commissioning plan will be developed by the Commissioning Authority. Upon request of the Commissioning Authority, the Contractor shall provide assistance and consultation. The commissioning plan will be developed prior to completion of the installation. If system modifications, clarifications are incorporated in this and related sections of work, commissioning of the work will be made at no additional cost to the Owner. If Contractor-initiated system changes have been made that alter the commissioning process, the Commissioning Authority will notify the Architect and the Contractor may be obligated to test the revised product, or confirm the suitability/unsuitability of the substitution or revision.
- C. Specific pre-commissioning responsibilities in accordance with section 01 25 00 substitution procedures are as follows:
 - 1. Factory trained technician for start-up, checkout, and calibration services for the following items of equipment:
 - a. Sensors.
 - b. Controlled devices.
 - c. Stand-alone or packaged controls.

- d. Local loop control panels.
 - e. Network controllers.
 - f. Field interface panels.
 - g. Central Processing Units.
 - h. Printers.
 - i. Basic Software Routines.
 - j. Software loop tuning.
2. Normal start-up services required to bring each system into a fully operational state. This includes electrical continuity checking, elimination of ground faults, sensor calibration, control sequences of operation, interlocks. This also includes all software and hardware to render fully operational control system.
- D. The Commissioning Authority will not begin the commissioning process until each system is complete, and functionality verified by the Contractor.
1. The Contractor shall independently complete all the pre-functional tests of the control system.
 2. Commissioning is intended to begin upon completion of a system. Commissioning may proceed prior to the completion of systems and sub-systems, if expediting this work is in the best interests of the Owner. Commissioning activities and schedule will be coordinated with the Contractor. Start of commissioning before system completion will not relieve the Contractor from completing those systems as per the schedule

3.2 PARTICIPATION IN COMMISSIONING

- A. Provide skilled technicians to start-up and debug all systems. These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technicians(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and problem resolutions.
- B. System problems and discrepancies may require additional technician time, Commissioning Authority time, redesign and reconstruction of systems, and the system components. The additional technician time shall be made available for the subsequent commissioning periods until the required system performance is obtained.
- C. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system and sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment and an attitude and willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.

3.3 WORK TO RESOLVE DEFICIENCIES

- A. In some systems, misadjustments, misapplied equipment, and deficient performance under varying loads will result in additional work being required to commission the system. This work will be completed under the direction of the Architect with input from the Contractor, equipment supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Owner will have final jurisdiction on the necessary work to be done to achieve performance.

- B. Corrective work shall be completed in a timely fashion to permit the timely completion of the commissioning process. Experimentation to render system performance will be permitted. If the Commissioning Authority deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Authority will notify the Architect, indicating the nature of the problem, expedited steps to be taken, and the deadline for completion of activities. If the deadline(s) passes without resolution of the problem, the Owner reserves the right to obtain supplementary services and equipment to resolve the problem. Costs incur to solve the problems in an expeditious manner will be the Contractor's responsibility.

3.4 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

- A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.
- B. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Heating equipment will be tested during winter design extremes. Cooling equipment will be tested during summer design extremes, with a fully occupied building. Each Contractor and supplier will be responsible to participate in the initial and the alternate peak season test of the systems.
- C. Subsequent commissioning may be required under conditions of minimum and maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum and peak loads to observe system performance. Each Contractor and supplier will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

3.5 TRAINING

- A. A training session, before functional testing starts, shall be conducted with sufficient detail and duration to give the Commissioning Authority a complete working knowledge of the control/facility automation system. This training shall provide all necessary software, passwords, reference materials, and proprietary hardware necessary to allow the Commissioning Authority to interrogate all points of the control/facility automation system, view all installed software routines, temporarily override all setpoints, on status and values, and trend/log available data. It is understood that the Commissioning Authority will use the system access for testing purposes only and will return all overridden values to their previous state.
- B. Owner training will be conducted jointly with the Commissioning Authority, the design engineers, the equipment vendors, and the Contractor. The Contractor will be responsible for the generic training, as well as instructing the Owner's staff on the system peculiarities specific to the project.

3.6 SYSTEMS DOCUMENTATION

- A. In addition to the requirements of Division 1, update Contract Documents to incorporate field changes and revisions to system designs to account for actual constructed configurations.
- B. In addition to the stated requirements for operation and maintenance data, provide one copy of equipment technical literature, operation and maintenance literature, and shop drawings to the Commissioning Authority as soon as they are available. This requirement is for review of these documents prior to distribution of multiple copies for the Owner's final use.

3.7 SOFTWARE

- A. The Contractor shall supply the Commissioning Authority with two debugged printouts of all facility management systems software including all users' programming and engineering manuals required to interpret the software. Included in the printouts but not limited to, shall be the following:
1. Point database.
 2. All custom control programs written in the BAS control language.
 3. All parameters required for proper operation of BAS control and utility firmware such as start/stop routines, etc.
 4. System graphics.
- B. The software printout shall be fully documented for ease of interpretation by the Commissioning Authority and Owner, without assistance from the Contractor. English language descriptions shall be either integrated with or attached to the BAS printout. The following shall be specifically documented:
1. All point names, I/O and virtual.
 2. All BAS programming language commands, functions, syntax, operators, and reserved variables.
 3. Use of all BAS firmware.
 4. The intended actions, decisions, and calculations of each line or logical group of lines in the custom control programs. Sequences of operations alone are not sufficient.
 5. Complete descriptions of and theories explaining all software and firmware algorithms. The algorithms to be described include, but are not limited to, PID, optimum start/stop, demand limiting, and chiller and boiler optimization.
 6. A table of contents to the documentation which locates the sections of the documentation and describes which programs or program sections are for each piece of controlled/monitored equipment.

END OF SECTION 23 09 99

SECTION 232113 - HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Air-vent piping.
 - 4. Safety-valve-inlet and -outlet piping.
- B. Related Sections include the following:
 - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
 - 2. Division 23 Section "Common Work for HVAC" for piping welding and common piping system components for HVAC.
 - 3. Division 23 Section "Vibration and Seismic Controls" for vibration and seismic controls including flexible piping connections to pumps, chillers, air handling units, rotating equipment and IFB coils.
- C. Where plumbing systems connect to equipment provided or installed under Division 23, work under Division 22 shall terminate the plumbing systems within 5 feet of final connection point of the equipment with a shutoff valves as specified in the plumbing valve section. Final connection to the equipment provided or installed under Division 23 shall be provided as part of this section. Final connection shall include additional valves, strainers, control valves, check valves, miscellaneous connections, etc. as shown on HVAC details, HVAC drawings, or as specified herein.

1.3 MECHANICAL SLEEVE SEALS

- A. Provide a sealing element made of synthetic rubber material, compounded to resist aging, ozone, sunlight, water and chemical action, and having a low temperature flexibility and resistance to high temperature environments. Elements shall be suitable for temperature ranges of minus 100°F to 600°F.
- B. Bolts and metal parts shall be made of carbon steel and zinc phosphate plated to resist corrosion. Pressure plates shall be cathodic-type made of plastic.
- C. The seals shall be constructed so as to be air tight in aboveground installations, and to provide watertight sealing in below grade installations.

- D. Seals shall be manufactured by Thunderline Corporation or approved equivalent.

1.4 HVAC PIPING SYSTEM PRESSURE CLASSIFICATION

- A. Piping, fittings, components, and equipment for the various HVAC piping systems shall meet the following pressure requirements:

HVAC Piping System	Operating Pressure	Component Pressure Rating	Drawing Symbol
1. Chilled water supply and return	100	125	CHWS, CHWR
2. Heating water supply & return	100	125	HWS, HWR, GWS, GWR

1.5 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.
- B. Piping and fitting materials shall conform to the specification standards of the recognized standards listed herein. References shall be to the latest edition in force at the time of bidding.
- C. Each pipe length shall have the manufacturer's name cast, stamped, or rolled on.
- D. Each fitting shall have the manufacturer's symbol and pressure rating cast, stamped, or rolled on.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS MATERIAL SCHEDULE

- A. Piping systems shall be constructed of the following materials as scheduled below, subject to approval by authorities having jurisdiction.

Systems	Pipe	Fittings	Remarks
Relief valve discharge piping for water systems	Type L hard drawn copper tubing with 95-5 tin antimony solder joints	Cast bronze or wrought copper with solder joints	

Systems	Pipe	Fittings	Remarks
Interior building hydronic heating system piping 2 inches and smaller	Type L hard drawn copper tubing with 95-5 tin antimony solder joints	Cast bronze or wrought copper with solder joints	Provide dielectric unions for ferrous to non-ferrous pipe connections
	Schedule 40 black steel pipe. Standard weight above 10 inches	Screwed cast iron fittings	
Interior building hydronic heating system piping 2-1/2 inch and larger	Schedule 40 black steel pipe. Standard weight above 10 inches	Welded steel fittings	Provide dielectric unions for ferrous to non-ferrous pipe connections
Interior building or above ground domestic water systems, 4 inches and smaller (cold, hot & hot water circulating systems)	Type L hard drawn copper tubing with 95-5 tin antimony solder joints	Cast bronze or wrought copper with solder joints	Fitting pressure rating per ANSI B16.22, B16.18, 125 lb. steam and 300 lb. steam
Cooling coil condensate piping	Type L hard drawn copper tubing with 95-5 tin antimony solder joints	Cast bronze or wrought copper with solder joints	
Refrigerant piping	Type ACR hard drawn copper tubing with brazed joints	Wrought copper braze type fittings brazed with silver alloy equivalent to Sil-Fos	Fitting pressure rating per ANSI B16.22. Maximum pressure 295 psi.
Interior chilled water piping 2 inches and smaller	Type L hard drawn copper tubing with 95-5 tin antimony solder joints	Cast bronze or wrought copper with solder joints	Provide dielectric unions for ferrous to non-ferrous pipe connections
	Schedule 40 black steel pipe. Standard weight above 10 inches	Screwed cast iron fittings	
Interior building piping 2-1/2 inches and larger	Schedule 40 black steel pipe. Standard weight above 10 inches	Welded steel fittings	Dielectric unions for ferrous to non-ferrous pipe connections

2.2 AIR CONTROL DEVICES

A. Manual Air Vents

1. Air vents for terminal heating units, unit heaters, finned tube radiation, etc., shall be 1/8 inch male screwdriver type manual air vents suitable for system pressure.
2. Air vents for air handling unit coils shall be ¼ inch petcocks.

B. Automatic Air Vents

1. Automatic air vents shall vent automatically with float principle; bronze body and nonferrous internal parts; 150 psig working pressure (300 psig for chilled water system); 240 deg F operating temperature; with NPS ¼ discharge connection and NPS ½ inlet connection; Air vent shall be Hoffman #79 and no others
2. Provide automatic air vents in accessible location at high point of each system (supply and return piping) and where shown on the plans.

C. High Capacity Air Vents

1. Provide float actuated high capacity air vents designed to purge free air from the system and provide shutoff at pressure up to 150 psig at a maximum temperature of 250 degrees F. The design of the high capacity air vents shall prevent air from entering the system if system pressure should drop below atmospheric pressure. The high capacity air vents shall purge free air at pressures up to 150 psig during normal system operation. The high capacity air vents shall be constructed of cast iron and fitted with components of stainless steel, brass and EPDM.
2. Provide high capacity air vents above the cold water fill piping connections to the air separators serving the hot water heating system and the chilled water system.
3. High capacity air vents shall be ITT Bell & Gossett Model 107A or approved equivalent by Spriax Sarco or Armstrong International.

2.3 DRAIN VALVE AND CAP

- A. Drain valve shall be equivalent to Watts B-6000-CC ¾ inch boiler drain valve.
- B. Drain valve cap shall be brass gasketed cap capable of withstanding continuous full line pressure.
- C. Provide drain valve and cap at the bases of risers, downstream of flow shut off valves and as shown on drawings and specified herein.

2.5 HYDRONIC PIPING SPECIALTIES

A. Strainers

1. Strainers up to 4 inches for water and for steam shall be "Y" type, full pipe size and fitted with blow-off ball valves. Basket screens shall be brass, with perforations suitable for intended service.
2. Strainers over 4 inches shall be basket strainers, full pipe size and fitted with blow-off gate valve. Basket screens shall be brass, with perforations suitable for intended service.
3. Provide strainers as indicated on the drawings.
4. Acceptable Manufacturers and models:

- a. "Y" Type: Mueller No. 11 or Mueller No. 758; Watts No. 77S or Watts No. 77F-D; Sarco Type IT or Sarco IF-125.

2.6 PIPE SLEEVES AND ESCUTCHEON PLATES

- A. Provide sleeves for piping passing through roofs, floors, ceilings, walls, partitions, air handling equipment, structural members, and other building parts.
- B. Sealant shall be equivalent to Dow Corning 795 Silicone Sealant for general purpose use and Dow Corning 786 Mildew Resistant Silicone Sealant for Kitchen, Food Preparation, Dining areas, and wet areas. Prime sleeves in accordance with manufacturer's recommendations.
- C. Sealant in one-hour and two-hour walls and one-hour and two-hour floors shall be equivalent to Dow Corning Fire Stop System Sealants and Foams. Sealants and foams shall be UL listed and installed in accordance with manufacturer's recommendations.
- D. Schedule of Sleeve Materials

Sleeve Type	Sleeve Material
1	18 gauge galvanized steel
2	Std. weight galvanized steel pipe
3	Std. weight galvanized steel pipe with a continuously welded water stop of 1/4 inch steel plate extending a minimum of 2 inches from the outside of the sleeve. (F&S Mfg. Co. Figure 204 or approved equal.)
4	Cast iron pipe sleeve with center flange. (James B. Clow & Sons No. F-1430 & F-1435, or approved equal.)
5	Std. weight galvanized steel pipe with flashing clamp device welded to pipe sleeve or watertight sleeves. (Josam 1870-A2 with oakum and lead caulking as required, or approved equal.)
6	Metal deck and wall sleeves.

E. Escutcheon Plates

- 1. Schedule of Escutcheon Plate Materials

Location	Escutcheon Plate Material
Finished spaces	Anodized aluminum or chrome-plated brass
Unfinished spaces	Plain brass, cast iron or aluminum

2.7 MECHANICAL SLEEVE SEALS

- A. Mechanical seals shall be provided for all floor/slab penetrations, exterior wall penetrations, and equipment penetrations (custom penthouse and heat recovery module).
- B. Mechanical seal shall be installed with corresponding sleeve designed for the mechanical seal.
- C. Provide a sealing element made of synthetic rubber material, compounded to resist aging, ozone, sunlight, water and chemical action, and having a low temperature flexibility and

resistance to high temperature environments. Elements shall be suitable for temperature ranges of minus 100°F to 600°F.

- D. Bolts and metal parts shall be made of carbon steel and zinc phosphate plated to resist corrosion. Pressure plates shall be cathodic-type made of plastic.
- E. The seals shall be constructed so as to be air tight in aboveground installations, and to provide watertight sealing in below grade installations.
- F. Seals shall be Link-Seal product manufactured by Thunderline Corporation or approved equivalent.

2.8 PIPE FLASHING FITTINGS

- A. Pipes passing through roof construction shall be provided with roof curb and piping portal.

PART 3 - EXECUTION

3.1 GENERAL

- A. The drawings schematically indicate the size and location of piping. Piping system layout shall be modified as required to meet field conditions and facilitate coordination among contractors at no additional cost. Piping shall conform to the latest ASA code for pressure piping. Unless otherwise noted, all piping, valves, and associated fittings shall be concealed behind walls, above ceilings, or below floors.
- B. Provide adequate provision for expansion and contraction in portions of the piping systems, to prevent undue strains on piping and connected equipment.
- C. Provide approved bolted, gasketed flanges for each piece of equipment to permit easy connection and disconnection. Screwed unions with steel faces may be used on piping 1 inch and smaller.
- D. Inlet/outlet piping connections to coils and equipment shall be provided with offsets and shutoff valves arranged such that equipment can be serviced or removed without dismantling the pipe.
- E. Converging and diverging bullhead tee's will not be permitted in piping systems.
- F. "T" drill type fittings, Victaulic and Pro-press will not be permitted in piping systems.
- G. If, after systems are in operation, any coils or other apparatus become stratified or air-bound, they shall be repiped with necessary fittings, air vents or vacuum breakers at no additional cost. If connections are concealed behind construction, the responsible Contractor shall bear the cost of any demolition and refinishing construction required.
- H. Pitch water piping up in direction of flow to ensure adequate flow without air binding and to prevent noise and water hammer. Branch connections to mains shall be made in such a manner as to prevent air trapping and prevent free passage of air. Mains shall be laid out to meet field conditions, maintain adequate headroom and clear work of other Contractors.

- I. Miscellaneous drains, vents, reliefs, equipment/tank overflows and similar devices shall be run to the nearest floor drain or roof drain. Provide drain valves wherever required for complete drainage of water system piping, including the system side of pumps.
- J. Provide accessible ball valve and 1/2 inch piping from top of closed loop system to nearby floor drain or mop basin for air venting.
- K. Any piping passing through roof construction shall be arranged to provide a minimum of 12 inches clearance from walls or other obstructions so as to permit proper flashing. Set pipe flashing fittings at a suitable level above the roof to permit proper termination of flashing.
- L. Provide hose drain connections on water systems downstream of floor main shut off valves.
- M. Provide dielectric fittings equivalent to EPCO Sales at all ferrous to non-ferrous pipe connections.

3.2 PIPING SYSTEM PRESSURE TESTS

- A. The following procedures shall be observed for piping system pressure tests:
 - 1. Take all due precautions to prevent damage to the building and its contents that may be incurred by such tests; repair or make good any damage caused by the tests at no additional cost to the Owner.
 - 2. Tests shall apply full test pressure to the piping for a sufficient period of time to detect leaks and defects.
 - 3. Tests shall be conducted prior to the installation of any required fitting insulation. If delicate control mechanisms, not including control valves, are installed in the piping, they shall be removed to prevent shock damage.
 - 4. The section of piping to be tested shall be brought up to the specified test pressure. If the test pressure falls more than the specified amount during the test period, the point of leakage shall be found, repaired and the test repeated. This procedure shall be repeated until the piping system has been proved absolutely tight.
 - 5. Leaks shall be repaired by removing the valve, fitting, joint or section which is leaking and reinstalling new materials and joints as specified. Use of mastic, "no-leak" compounds or other temporary means of repairing leaks shall not be permitted.
 - 6. System pumps, heat exchangers, etc., shall not be used until final flushing is done. Provide necessary temporary pumps required for flushing.

3.3 HYDRONIC HEATING WATER AND CHILLED WATER SYSTEMS

- A. Hydronic Heating Water and Chilled Water Systems Flushing
 - 1. After piping installation is complete but before final connections are made to the equipment, control valves, etc., thoroughly flush the supply and return piping with fresh water. Flushing shall continue until clear water flows from drains or for two hours, whichever is longer. The isolation valves to all valves shall be closed with the flushing bypass valves open. When complete the flushing bypass valves shall be closed and the coil isolation valves shall be opened with a final flush.
 - 2. After clear water flushing, operate pumps (provide temporary pumps) for a minimum of 8 hours with a "start-up" fine mesh strainer. Clean strainer after 8 hours of operation then operate pump for 24 hours. Remove start-up strainer, replace bypass filter, and clean remaining strainers.

3. Pump flow rate and head shall be equal to flow rate required for the installed system. Water systems (hot water and chilled water) shall not be connected until flushing is complete. Notify Architect 5 days before temporary pumps are started.

B. Hydronic Heating Water and Chilled Water Systems Pressure Tests

1. Test piping systems hydrostatically using water not exceeding 100°F. Conduct tests in accordance with the requirements of ANSI B31.1 and as follows:
 - a. Test the piping after the lines have been cleaned and prior to applying insulation and covers to fittings.
 - b. For piping systems with pressures below 175 psig, test piping systems at a pressure equal to twice the system's operating pressure or 50 psig, whichever is greater. For piping systems with pressures 175 psig and above, test piping systems at 350 psig.
 - c. Prior to testing, remove or valve-off from the system gauges, traps, and other apparatus which may be damaged by the testing.
 - d. Install calibrated test pressure gauge in the system to observe any loss in pressure.
 - e. Maintain the required test pressure for a sufficient length of time to enable an inspection of joints and connections.
 - f. Tests shall be performed after installation of the piping systems and prior to acceptance of same.

3.4 REFRIGERANT PIPING

A. Refrigerant Piping Pressure Test

1. Test piping prior to installation of insulation.
2. Purge piping system with nitrogen during installation.
3. Provide nitrogen and pressurize to 125 psig on the high side and 125 psig on the low side. Leak check with bubble solution. If pressure drops or if leaks are detected, provide new piping, fittings, and connections as required. System shall be recharged and purged with nitrogen before brazing. Locate leak in a manner approved by the EPA or other governing agencies.
4. Maintain the required test pressure for a sufficient length of time to enable an inspection of all joints and connections.
5. Tests shall be performed after installation of the piping systems and prior to acceptance of same.
6. Provide appropriate vacuum pump and evacuate refrigerant piping to 500 microns. Allow system to stand under vacuum of 500 microns for four (4) hours. If the vacuum reading remains unchanged, the system is ready to receive its charge of refrigerant.
7. Charge refrigerant systems in accordance with manufacturer's recommendations.

3.5 PIPE SLEEVES

- A. Install sleeves in time to permit construction progress as scheduled.
- B. Grout sleeves to building structure for watertight fit.

C. Schedule of Sleeve Lengths

Location	Sleeve Length
Floors	Equal to depth of floor construction and at least 1 inch above finished floor construction. In waterproof floor construction, sleeves shall extend a minimum of 2 inches above finished floor construction
Roofs	Equal to depth of roof construction including insulation
Walls and Partitions	Equal to depth of construction and terminated flush with finished surfaces

D. Schedule of Sleeve Caulking and Packing

Caulking/ Packing Type	Caulking/Packing Requirements
A	Space between pipe and sleeve shall be packed with oakum and caulked watertight with lead.
B	Space between pipe or pipe covering and sleeve shall be caulked with an incombustible permanently plastic waterproof, non-staining compound leaving a smooth, finished appearance.
C	Vermiinproofing - space between pipe and sleeve shall be packed with industrial felt or fiberglass caulked at both ends with sealant according to manufacturer's recommendations. Vermiinproof insulation shall be minimum 1 inch thickness and shall be sections of foam glass as long as sleeves.

E. Schedule of Sleeve Applications

Location	Sleeve Type Thru Fire Rated Construction	Sleeve Type Thru Non-Fire Rated Construction	Sleeve Caulking and Packing Type
Membrane water-proof floor, roof and wall construction	5	5	C
Non-membrane waterproof floor, roof and wall construction where flashing is required	5	5	C
Interior walls, partitions, and floors	2	1 or 2	C
Exterior walls	---	3 or 4	C
Cellular metal deck floors	2	6	B
Precast concrete floor with poured concrete topping (NOTE: sleeves with flat flanges or guides which rest on top of precast slab required)	--	1	B

3.6 PIPE FLASHING FITTINGS

- A. Any pipe passing through roof construction shall be arranged to provide a minimum of 12 inches clearance from walls or other obstructions so as to permit proper flashing.

3.7 DRIP PANS FOR PROTECTION OF ELECTRICAL EQUIPMENT

- A. Examine the drawings and in cooperation with the Electrical Contractor confirm the final location of electrical equipment to be installed in the vicinity of piping. Plan and arrange overhead piping no closer than 2 feet from a vertical line to electric motors and controllers, switchboards, panel boards, or similar equipment. Piping is not permitted in electric equipment rooms, transformer rooms, switchgear rooms, nor telephone gear rooms.
- B. Where the installation of piping does not comply with the requirements of foregoing paragraph, where feasible, the piping shall be relocated.
- C. Where piping cannot be relocated, furnish gutters as follows:
 - 1. Provide and erect a gutter of 16 ounce cold rolled copper or heavy galvanized steel, under every pipe which is within 2 feet from a vertical line to any motor, electrical controllers, switchboards, panel boards, or the like.
 - 2. Each gutter shall be soldered and made watertight, properly suspended and carefully pitched to a convenient point for draining. Provide a 3/4 inch drain, with valve as directed, to nearest floor drain or slop sink, as approved.
 - 3. In lieu of such separate gutters, a continuous protecting sheet of similar construction adequately supported and braced, properly rimmed, pitched and drained, may be provided over any such motor, and extending 2 feet in all directions beyond the motor, over which such piping has to run.

3.8 STRAINERS

- A. Strainers shall be installed such that they are accessible for maintenance and inspection.
- B. Strainers shall be installed in a horizontal (or vertical downward) run of pipe. Strainers shall be arranged so as to permit the blowing out of accumulated dirt, and to facilitate removal and replacement of strainer screen without disconnecting from piping system.
- C. Valved dirt blow-out connections for strainers 2 ½ inches and larger shall be installed such that the valve is located 6 inches to 12 inches below the strainer. Blow-out connections shall be terminated in an approved manner, at a point where there shall be no risk of flooding or damage.
- D. After the piping systems have been flushed and prior to releasing the system to the Owner, strainers shall be removed, cleaned, and reassembled.

3.9 AUTOMATIC AIR VENT

- A. Provide vent in accessible location at top of system to allow for maintenance.

3.10 BACKFLOW PREVENTERS

- A. Extend drain piping from backflow preventers to nearest floor drain.

3.11 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice balancing valves at each branch connection to return main riser.
- C. Install automatic flow control valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.14 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.15 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens. Refer to the Water Treatment specifications.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL

- A. The following work consists of providing all labor, material and equipment for cleaning and flushing piping systems.

PART 2 - PRODUCTS

2.1 CHEMICAL TREATMENT SUBCONTRACTOR

- A. The mechanical contractor must contact Montgomery College Facilities during the bidding process to obtain the name and contact information for the existing on-site chemical treatment contractor. The mechanical contractor is to obtain pricing from the designated chemical treatment contractor for the flushing and chemical treatment of the Science West Building.

2.2 GENERAL

- A. Refer to Section 232113 for component and equipment ratings. All components, fittings, equipment, coils, specialties, etc., shall meet the component pressure rating listed.

2.3 Test Coupons

- A. Provide test coupons where required for a complete system.

2.4 EXISTING SYSTEM CONNECTION FOR CHILLED WATER AND HEATING HOT WATER

- A. The chilled and hot water systems will be connected to the existing central plant and satellite plant which treat the building water.

2.5 GLYCOL SOLUTION MAKE-UP UNIT - GLYCOL SYSTEMS

- A. The package shall consist of a base, polyethylene reservoir with removable lid and visible solution level scale in gallons and liters, y-strainer, isolation valve, pump, open drip-proof motor, pump isolation, check and balance valve, expansion tank, discharge pressure gauge, motor contactor, pressure control and necessary interconnecting piping. Pump shall start based on falling pressure. Green light shall indicate power supplied to unit.
- B. System shall have a 115/1/60 single point power connection and a ¾" NPT system piping connection.
- C. The unit shall provide 5 GPM and maintain a fill pressure of 30 PSI. Unit to include a low level cutout with red indicator light and a dry contact for alarm indication, to stop the pump during low level condition.

- D. Contractor shall provide an application specific pressure reducing valve between the make-up unit and connection to the system piping.
- E. Glycol solution make-up unit shall be Wessels GMP-18 or approved equal.

PART 3 - EXECUTION

3.1 INITIAL CLEANOUT SPECIFICATION - HOT WATER HEATING SYSTEMS, CHILLED WATER SYSTEMS

- A. Screens/strainers shall be in place and chemical feed system installed before initial cleanout begins.
- B. The central plant or satellite plants shall not be connected to the building until the flushing procedure is complete. The contractor is responsible to fill the system from the SE building and provide the required chemicals and connections to do so. All temporary chemical feeders, bypass lines and temporary pumps shall also be provided.
- C. Fill system with water and simultaneously add manufacturer's non-foaming chemical detergent equal to Nalco 2567 to recommended dosage based on total system capacity through chemical feed system.
- D. Circulate water continuously for 24 to 36 hours.
- E. Immediately after recirculation, so that removed and suspended foulants will not resettle, drain system.
- F. Remove, clean, and replace all strainers.
- G. Immediately after steps 4 and 5 above, so as to prevent corrosion from taking place on empty piping, fill the system adding 1/4 the theoretical dosage of the selected treatment, recirculate for a minimum of 4 hours, maximum of 24 hours. Then drain or purge system.
- H. Immediately after step 6, refill system while adding total required dosage of selected treatment equal to Nalco 2536. Continue to recirculate for a minimum of 24 hours to allow total film formation.
- I. Provide certification by chemical treatment representative that system is properly cleaned and ready for startup.

3.2 INITIAL CLEANOUT SPECIFICATION - GLYCOL WATER SYSTEMS

- A. Screens/strainers shall be in place and chemical feed system installed before initial cleanout begins.
- B. Fill system with water and simultaneously add manufacturer's non-foaming chemical detergent equal to Nalco 2567 to recommended dosage based on total system capacity through chemical feed system.
- C. Circulate water for 24 to 36 hours.
- D. Immediately after recirculation, so that removed and suspended foulants will not resettle, drain system.

- E. Remove, clean, and replace all strainers.
- F. Immediately after steps 4 and 5 above, so as to prevent corrosion from taking place on empty piping, fill the system adding 1/4 the theoretical dosage of the inhibitor treatment similar to Nalco 2536, recirculate for a minimum of 4 hours, maximum of 24 hours. Then drain the system.
- G. Immediately after step 6, refill system with premixed solution of 35 percent propylene glycol. Circulate solution for at least 24 hours to insure complete mixing with any residual water left in the system. Check solution concentration.
- H. Drain system of volume required and add 100 percent concentrate of propylene glycol to insure correct mixture. Circulate solution for at least 24 hours to insure complete mixing. Recheck solution concentration.
- I. Repeat step 8 until compliance with Specification is obtained.
- J. Provide certification by the chemical treatment representative that the system is properly cleaned and ready for startup.

3.3 WATER TREATMENT PROGRAM - GLYCOL WATER SYSTEMS

- A. Provide initial fill chemicals plus provide chemicals and maintain specified chemical levels for a period of one year.
- B. Glycol Solution
 - 1. The water glycol solution delivered to the site for initial fill shall be a premixed solution of propylene glycol and distilled water. Solution shall be 35 percent by volume propylene glycol.
 - 2. The solution should be dyed red for easy leak detection.
 - 3. The solution should contain an industrial grade inhibitor to limit corrosion.
 - 4. The solution should be easily analyzed and re-inhibited.
- C. Inhibitor and pH Control
 - 1. The chemical treatment company shall analyze the water quality at the site to determine if the water is of adequate quality, i.e., not containing excessive quantities of chlorides, sulfate, ammonia, or other contaminants which might deplete the solution inhibitors or upset the solution pH. Based on this analysis, the chemical treatment company shall furnish sufficient quantities to premixed solution or 100 percent solution of ethylene glycol to make up all quantities lost during the first year. He shall also add sufficient inhibitors as required to make up those dissolved or lost throughout the first year.
- D. Corrosion Coupons
 - 1. Install a minimum of eight (8) black carbon steel-type coupons per ASTM 2688-D method to simulate corrosion on glycol water system wetted parts of each glycol water system. Locate coupons in locations deemed to reflect the most corrosive system condition.
- E. Guarantee
 - 1. Protect various dissimilar materials of construction.
 - 2. Corrosion rate of ferrous metals shall not exceed 1.0 mils penetration per year.
 - 3. Treatment system shall not permit fouling to cause equipment capacity reduction beyond the allowed 0.0005 "fouling factor."

END OF SECTION 232500

SECTION 233100 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa). Metal ducts include the following:
 - 1. Rectangular ducts and fittings.
 - 2. Single-wall, round spiral-seam ducts.
 - 3. Double-wall, rectangular, round and flat-oval spiral-seam ducts.
- B. Related Sections include the following:
 - 1. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. NUSIG: National Uniform Seismic Installation Guidelines.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.
- B. Welding: Qualify procedures and personnel according to [AWS D1.1, "Structural Welding Code--Steel," for hangers and supports] [AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members] [and] [AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding].
- C. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- D. Mockups:
 - 1. Before installing duct systems, build mockups representing pressure classes higher than 2-inch wg. Build mockups to comply with the following requirements, using materials indicated for the completed Work, and include each of the following features and fittings:

- a. Five transverse joints.
 - b. One access door(s).
 - c. Two typical branch connections, each with at least one elbow.
 - d. Two typical flexible duct or flexible connector connections for each duct and apparatus.
 - e. Perform tests specified in Part 3 "Field Quality Control" Article. Modify mockup construction and perform additional tests as required to achieve specified minimum acceptable results.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. When the specifications refer to SMACNA Standards, they shall be considered as minimum standards; if local codes or requirements specified herein require more restrictive standards than described in SMACNA, the local codes and requirements specified herein shall govern.
- B. Ductwork indicated on drawings is schematic; therefore, changes in ductwork sizes and/or location shall be made when necessary to conform to space conditions. Changes shall be made at no additional cost to the Owner. The engineer shall be consulted for approval of duct size changes which cannot maintain the same equivalent free area dimensions or which require an aspect ratio greater than 4 to 1. Change in duct sizes shall be made with transitions. Transitions shall have not more than a 30° angle parallel to the airflow for a one sided transition or 15° angle for a two sided transition.
- C. Duct dimensions indicated on drawings shall be the clear inside dimensions. Provide hat section at turning vanes, dampers, etc., as indicated in SMACNA Figure 2-24.
- D. Ductwork shall be constructed true to sizes indicated and shall be airtight with a smooth appearance.
- E. Coil frames, damper frames, louver frames, etc., shall be bolted and sealed to ductwork.
- F. Provide additional bracing and reinforcing as necessary to prevent buckling and bulging of ductwork.
- G. Provide pre-fabricated panel casings for outside air intake plenums and relief air plenums as shown on drawings and as hereinafter specified.
- H. Existing ductwork, where demolition is required, shall be properly terminated in accordance with SMACNA standards for +4 or -2 pressure rating, depending on flow.
- I. Ductwork located outdoors shall be Type 304 stainless steel. Reinforcing, bracing, etc., shall be designed in accordance with SMACNA standards for the pressure classification listed in Paragraph 2.2.
- J. Where specifications require stainless steel or aluminum ductwork for a particular duct system [including ductwork located outdoors], all components including but not limited to turning vanes, control dampers, volume dampers, fire dampers, combination fire/smoke dampers, smoke dampers, reinforcing, bracing, sound attenuators, and supports shall be same type as duct material.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
- D. Stainless Steel: ASTM A 480/A 480M, Type 316 and having a No. 2D finish.
- E. Aluminum Sheets: ASTM B 209 alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- B. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.
- C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
- D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
 3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
 3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

2.5 DUCTWORK TYPES

<u>Type</u>	<u>Location</u>
Single-wall, round spiral-seam	Diffuser branches
Double-wall rectangular	Shafts
Double-wall flat oval	Mains before and after terminal units
Double-wall round	After terminal units
Single-wall rectangular	Exhaust and return ductwork

2.6 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
1. Manufacturers:
 - a. Ductmate Industries, Inc. and no others.
- C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.

- D. Elbows shall be of radius construction with throat radius equal to or greater than the width of the duct unless otherwise indicated. Square construction with double radius turning vanes may be used where space limitations prohibit radius construction. Radius elbows with square throats are not permitted.

2.7 RECTANGULAR DOUBLE WALL DUCTWORK

- A. Panels shall be 2 inch thick with interior solid panel sheets galvanized steel. Exterior solid panel sheets shall be 18 gauge galvanized steel with galvanized coating suitable for painting. The insulation shall be installed between the two ducts. The insulation value and thickness shall comply with the rating in the duct insulation specification.
- B. Internal panel reinforcement shall be a minimum of 18 gauge stainless steel and spaced so that span does not exceed 2 feet.
- C. Prior to attaching the face sheet, the panel shall be filled with insulating fill. The fill shall be slightly larger and thicker than the inside dimensions of the panel. No voids will be tolerated. Insulation shall be 2 inches thick with a K-factor of 0.27 Btu/hr/sf/°F/inch at 75°F mean temperature.
- D. The face sheet shall be attached to the panel assembly so as to compress and hold the fill materials in place under severe conditions of vibration. Exterior joints shall be constructed with Ductmate fittings. TDC connection system is not permitted.
- E. Openings for fan and duct connections where required shall be provided by the ductwork manufacturer.
- F. The duct structure shall be normally self-supporting. Where roof spans and wall loadings require additional structural strength, it shall be furnished either by heavier roof and wall joiners or additional structural members.
- G. Duct installation shall be capable of withstanding a negative internal static air pressure of 2 inches and a positive pressure of 4 inches.
- H. Contractor may construct double wall ductwork upon shop drawing approval of shop methods and details.

2.8 ROUND DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round, Longitudinal- and Spiral Lock Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 - 1. Manufacturers:
 - a. McGill AirFlow Corporation.
 - b. SEMCO Incorporated.
 - c. Lindab
 - d. The Duct Connection
- C. Duct Joints:

1. Ducts up to 20 Inches (500 mm) in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 2. Ducts 21 to 72 Inches (535 to 1830 mm) in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 3. Ducts Larger Than 72 Inches (1830 mm) in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
 4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
 - a. Manufacturers:
 - 1) Ductmate Industries, Inc.
 - 2) Lindab Inc.
 - 3) McGill Airflow Corporation
 - 4) SEMCO Incorporated
 - 5) The Duct Connection
- D. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- E. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- F. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
 2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):
 - a. Ducts 3 to 36 Inches (75 to 915 mm) in Diameter: 0.034 inch (0.85 mm).
 - b. Ducts 37 to 50 Inches (940 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
 - c. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
 - d. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).
 3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg (500 to 2500 Pa):
 - a. Ducts 3 to 26 Inches (75 to 660 mm) in Diameter: 0.034 inch (0.85 mm).
 - b. Ducts 27 to 50 Inches (685 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
 - c. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
 - d. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).
 4. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 5. Round Elbows 8 Inches (200 mm) and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only.

Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

6. Round Elbows 9 through 14 Inches (225 through 355 mm) in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
7. Round Elbows Larger Than 14 Inches (355 mm) in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
8. Die-Formed Elbows for Sizes through 8 Inches (200 mm) in Diameter and All Pressures 0.040 inch (1.0 mm) thick with 2-piece welded construction.
9. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
10. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
11. Pleated Elbows for Sizes through 14 Inches (355 mm) in Diameter and Pressures through 10-Inch wg (2500 Pa): 0.022 inch (0.55 mm).

2.9 ROUND AND FLAT OVAL DOUBLE-WALL DUCT AND FITTING FABRICATION

A. Manufacturers:

1. Lindab Inc.
2. McGill AirFlow Corporation.
3. SEMCO Incorporated.
4. The Duct Connection

B. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.

1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches (50 mm) longer than inner duct and insulation and in metal thickness specified for single-wall duct.
2. Insulation: The insulation thickness shall comply with the "Supply-Concealed" ductwork type per the duct insulation specification. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.
3. Solid Inner Ducts: Use the following sheet metal thicknesses and seam construction:
 - a. Ducts 3 to 8 Inches (75 to 200 mm) in Diameter: 0.019 inch (0.5 mm) with standard spiral-seam construction.
 - b. Ducts 9 to 42 Inches (225 to 1070 mm) in Diameter: 0.019 inch (0.5 mm) with single-rib spiral-seam construction.
 - c. Ducts 44 to 60 Inches (1120 to 1525 mm) in Diameter: 0.022 inch (0.55 mm) with single-rib spiral-seam construction.
 - d. Ducts 62 to 88 Inches (1575 to 2235 mm) in Diameter: 0.034 inch (0.85 mm) with standard spiral-seam construction.
4. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.

C. Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.

1. Solid Inner Ducts: Use the following sheet metal thicknesses:
 - a. Ducts 3 to 34 Inches (75 to 865 mm) in Diameter: 0.028 inch (0.7 mm).

- b. Ducts 35 to 58 Inches (890 to 1475 mm) in Diameter: 0.034 inch (0.85 mm).
 - c. Ducts 60 to 88 Inches (1525 to 2235 mm) in Diameter: 0.040 inch (1.0 mm).
2. Perforated Inner Ducts: Fabricate with 0.028-inch- (0.7-mm-) thick sheet metal having 3/32-inch- (2.4-mm-) diameter perforations, with overall open area of 23 percent.

2.10 SLEEVES

- A. Provide sleeves for ducts passing through roofs, walls, floors and partitions. Sleeves are not required for double wall ductwork.
- B. Sleeve material shall be 20 gauge galvanized steel except for fire walls and smoke barriers which shall be 16 gauge galvanized steel.
- C. Sealant shall be equivalent to Dow Corning 795 Silicone Sealant for general purpose use. Prime sleeves in accordance with manufacturer's recommendations.
- D. Sealant in one-hour and two-hour walls and one-hour and two-hour floors shall be equivalent to Dow Corning Fire Stop System Sealants and Foams. Sealants and foams shall be UL listed and installed in accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

- A. Duct construction for the various duct systems shall have the following ratings:

<u>Duct System</u>	<u>Pressure Rating</u>
Interstitial Supply Ductwork	3 inches
Supply Duct Risers	3 inches
Horizontal Supply mains	3 inches
Supply Branches from mains	3 inches
Down stream of terminal boxes (supply)	1 inch
Return Ductwork	2 inches
Toilet / Copier Exhaust Ducts	-2 inches

- B. All ducts shall be galvanized steel except as noted on the drawings:

3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m) unless interrupted by fittings.
- C. Install ducts with fewest possible joints.

- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
 - E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.
 - F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
 - G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 - H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
 - I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
 - J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
 - K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
 - L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
 - M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
 - N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Penetration Firestopping."
 - O. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."
 - Q. Paint interiors of metal ducts, that do not have duct liner, for 24 inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.
- 3.3 SEAM AND JOINT SEALING
- A. Seal ducts before external insulation is applied.
 - B. Duct sealing shall meet duct seal Class A for all ductwork.

C. Additional duct sealing required for lab exhaust ductwork.

TABLE 1-2 DUCT SEALING REQUIREMENTS		
Seal Class	Sealing Required	Static Pressure Construction Class
A	All transverse joints, longitudinal seams and duct wall penetrations	All ductwork

3.1 SLEEVES

- A. Provide 1/2 inch clearance between duct or duct insulation and sleeve.
- B. Install sleeves in time to permit construction progress as scheduled.
- C. Grout sleeves to building for watertight fit.
- D. Schedule of Sleeve Lengths

Location	Sleeve Length
Floors	Equal to depth of floor construction and at least 1 inch above finished floor construction. In waterproof floor construction, sleeves shall extend a minimum of 2 inches above finished floor construction.
Roofs	Equal to depth of roof construction including insulation.
Walls and Partitions	Equal to depth of construction and terminated flush with finished surfaces.

E. Schedule of Sleeve Caulking and Packing Type

Caulking/ Packing Type	Caulking/Packing Requirements
A	Caulking not required.
B	Space between duct or duct covering and sleeve shall be vermin proof sealant.
C	Space between duct and sleeve shall be packed with industrial felt or fiberglass caulked at both ends with sealant according to manufacturer's recommendations. Vermin proofing for ducts with insulation shall be minimum 1 inch thick sections of foam glass as long as sleeve with space between foam glass and sleeve packed with industrial felt or fiberglass caulked at both ends with sealant in accordance with manufacturer's recommendations.

F. Schedule of Sleeve Applications

Location	Sleeve Caulking and Packing Type
Membrane water-proof floor, roof and wall construction	C
Non-membrane waterproof floor, roof and wall construction where flashing is required	C
Interior walls, partitions, and floors	C
Exterior walls	C

3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.
- E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections according to testing procedure in SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
- B. All Ductwork rated (per 3.1.A) between +2 inches w.g. and +10 inches w.g., (and from -2 inches w.g. to -10 inches w.g. pressure rating) shall be leak tested in accordance with the duct testing procedure in the most current version of SMACNA-HVAC "Air Duct Leakage Test Manual. Ductwork for sections tested shall be tested at 25 percent above operating pressure (not to exceed the duct rated pressure). At this test pressure, a total system leakage of 3 percent of the total system cfm shall be the maximum limit. When duct system is broken into convenient segments, allowable leakage must be apportioned to each segment.

- C. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.7 CLEANING NEW SYSTEMS

- A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
- B. Use service openings, as required, for physical and mechanical entry and for inspection.
 - 1. Create other openings to comply with duct standards.
 - 2. Disconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling sections to gain access during the cleaning process.
- C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.
- D. Clean the following metal duct systems by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
- F. Cleanliness Verification:
 - 1. Visually inspect metal ducts for contaminants.
 - 2. Where contaminants are discovered, re-clean and reinspect ducts.

END OF SECTION 233100

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Backdraft dampers.
2. Manual volume dampers.
3. Fire dampers.
4. Smoke dampers.
5. Combination fire and smoke dampers.
6. Flange connectors.
7. Sound Attenuators.
8. Turning vanes.
9. Duct-mounted access doors.
10. Flexible connectors.
11. Flexible ducts.
12. Duct accessory hardware.
13. Pressure Relief Doors

- B. Related Sections:

1. Division 28 Section "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.4 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: [G60 (Z180)] [G90 (Z275)].
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and [] finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BALANCING DAMPERS

- A. Balancing dampers for rectangular ductwork shall be opposed blade type, and shall be Ruskin Model MD35 Manual Balancing Damper with Locking Quadrant for duct pressure ratings 2 inches w.g. or less, and Ruskin Model CD30AF1 with Locking Quadrant for duct pressure ratings greater than 2 inches w.g.
- B. Balancing dampers for round ductwork shall be Ruskin Model MDRS25 Round Manual Balancing Damper with Locking Quadrant.
- C. Balancing dampers for oval ductwork shall be Ruskin Model CDO25 Oval Control Damper with Locking Quadrant.

2.3 FIRE DAMPERS

- A. Fusible link dampers shall be of the folding blade type, shall meet the requirements of NFPA Bulletin 90A, and shall be UL listed and tested in accordance with UL 555 test criteria. Provide fire dampers UL listed for installation in 1-1/2 hour or 2-hour fire separations or divisions.
- B. Fire dampers for vertical installation shall be gravity operated. Fire dampers for horizontal installation shall have closure springs and latches.
- C. Fire dampers shall have resettable reusable fire link rated at 165°F.

- D. Fire dampers installed in ductwork shall be Ruskin Model IBD2, Style C, CR, or CO to match duct shape. Maximum pressure drop: 0.05 inches w.g. at 1500 fpm face velocity.
- E. Equivalent manufacturers: Ruskin and no others.

2.4 DUCT ACCESS DOORS

- A. In general, access doors shall be at least 18 inches x 18 inches where physically possible; access doors for fire dampers shall be sized in accordance with the fire damper size.
- B. Access doors shall be of double construction and shall be gasketed around the entire perimeter to minimize air leakage between door and frame. Access doors in insulated ducts or casings, and fire damper access doors, shall be fully insulated with rigid fiberglass insulation between the metal panels.
- C. In no case shall access to any items of equipment require the removal of nuts, bolts, screws, wedges or any other loose devices.
- D. Access doors installed in ductwork 2 inches w.g. class and below shall be Ruskin Model ADH22 or approved equal.
- E. Access doors installed in ductwork above 2 inches w.g. class shall be Ruskin Model ADHP-3 High Pressure Access Doors or approved equal.

2.5 FLEXIBLE CONNECTIONS

- A. Flexible connections shall be a minimum of 8 inches long.
- B. Flexible connection shall be fabricated from approved flameproofed fabric in accordance with the applicable sections of the NFPA overall fire codes. Asbestos cloth is not permitted.

2.6 BACKDRAFT DAMPER

- A. Damper shall be pressure activated, vertical air flow with face linkage and an adjustable counter weight, with a range of positive pressure from .05 inches to .25 inches w.g.
- B. Frame shall be constructed of .090 inch thick extruded aluminum. Blades shall be formed from .025 inch aluminum. Blades shall have overlapping edges with extruded vinyl edge seals.
- C. Damper shall be Ruskin Model CBD2 or approved equal.

2.7 COMBINATION FIRE AND SMOKE DAMPER

- A. Maximum pressure drop for damper assembly shall be 0.05 inches w.g. at 1500 fpm duct face velocity.
- B. Dampers shall be UL listed and tested in accordance with UL 555 test criteria and shall be further qualified under UL 555S as a leakage rated damper for use in smoke control systems. The leakage rating shall be no higher than class 1 (4 cfm/sq.ft. at 1 inch w.g.) at 250°F elevated

temperature category. UL leakage ratings shall apply to sizes of dampers required herein, and elevated temperature ratings shall apply to operators as well as dampers.

- C. Each combination fire and smoke damper shall be equipped with a UL classified firestat which shall function to close damper when duct temperature exceeds 165°F. Firestat package shall include two damper position indicator switches, both linked directly to a damper blade, to provide capabilities of remotely indicating damper position. Firestat and damper position indicators shall have capability of interfacing electrically with smoke detectors, building fire alarm systems and remote indicating/control stations. Motor operator shall be 120volt electric actuated normally closed.
- D. Motor damper and firestat assembly shall have maximum draw of 4.0 amps.
- E. Firestat position indicator shall have capabilities of electrically locking damper in a closed position whenever duct temperatures exceed 165°F and the capability of permitting appropriate authority to override the smoke detector and re-open damper as may be required to permit desired smoke control functions only. Damper shall remain closed when firestat temperature is above 165°F.
- F. Combination motor/fire dampers shall be Ruskin FSD60 or equivalent.
- G. Firestat shall be Ruskin Model TS150 or equivalent.
- H. Equivalent manufacturers: Ruskin, Prefco, National Control Air, Safe-Air, Greenheck.

2.8 SMOKE DAMPERS

- A. Maximum pressure drop for damper assembly shall be 0.05 inches w.g. at 1500 fpm duct face velocity.
- B. Dampers shall be UL listed and tested in accordance with UL 555 test criteria and shall be further qualified under UL 555S as a leakage rated damper for use in smoke control systems. The leakage rating shall be no higher than class 1 (4 cfm/sq.ft. at 1 inch w.g.) at 250°F elevated temperature category. UL leakage ratings shall apply to sizes of dampers required herein, and elevated temperature ratings shall apply to operators as well as dampers.
- C. Motor operator shall be 120 volt electric actuated normally closed.
- D. Motor damper assembly shall have a maximum draw of 4.0 amps.
- E. Smoke dampers shall be Ruskin SD60 or approved equivalent.
- F. Equivalent manufacturers: Ruskin, Prefco, National Control Air, Safe-Air, Greenheck.

2.9 DUCT PRESSURE RELIEF DOOR

- A. Duct pressure relief doors shall be Ruskin PRD18 pressure relief door. Door shall be 12 gauge galvanized steel with polyurethane foam seal, adjustable to relieve pressures from 3 inches to 8 inches positive or negative.

2.10 THERMOMETERS

- A. Thermometer shall be Ashcroft 5 inch dial thermometer, 20°F to 120°F temperature scale, 9 inch stem length.

2.11 SOUND ATTENUATORS

- A. Provide sound attenuators as shown and scheduled on the drawings. The sound attenuator shall be equivalent to the basis of design.
- B. Sound attenuator casing shall be 22 gauge galvanized steel outer casing, 26 gauge galvanized steel inner partition except where noted. Seams shall be lock formed and mastic filled. If sound attenuators are located in a duct system specified as stainless steel, the sound attenuator shall also be stainless steel.
- C. Filler material shall be of inorganic mineral or glass fiber of density sufficient to obtain the specified performance. Filler material shall be packed under not less than 5 percent compression to eliminate voids due to vibration and settling. Materials shall be inert, vermin and moisture proof.
- D. Combustion rating for acoustical fill when tested in accordance with ASTM 84, NFPA 255 or UL No. 723 shall not be less than the following:

Flamespread Classification	25
Smoke Development Rating	15
Fuel Contribution	20

- E. Sound attenuators shall not fail structurally when subjected to a differential static pressure of 8 inches W.C.
- F. The holes in the perforated sheet shall be protected from dusting and moisture by polyethylene wrap. Dynamic insertion loss scheduled includes the reduction of the polyethylene wrap.
- G. The manufacturer shall provide certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance for reverse and forward flow conditions with submittals. Test data shall be for a standard product.
- H. Where required to make the sound attenuator fit in the ductwork design, the sound attenuator shall be custom.
- I. Product: IAC Quiet Duct or Vibro-Acoustics

2.12 TURNING VANES

- 1. Ductmate Industries, Inc.
- 2. Duro Dyne Inc.
- 3. METALAIRE, Inc.
- 4. SEMCO Incorporated.
- B. Turning Vanes for Metal Ducts shall be curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

- C. Manufactured turning vanes for nonmetal ducts shall be fabricated of curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vaness and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction shall be single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.
- F. Turning vanes in all ductwork shall be airfoil shape.

2.13 FLEXIBLE DUCTS

- A. Noninsulated, flexible duct shall be UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.
 - 1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
 - 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 - 3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
- B. Insulated, flexible duct shall be UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
 - 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 - 3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
- C. Flexible Duct Connectors:
 - 1. Clamps: [Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action] in sizes 3 through 18 inches (75 through 460 mm), to suit duct size and adhesive mastic.
- D. Refer to drawings for flex duct insulation requirements. The flexible duct to each air terminal unit shall be a small section to only provide a flexible connection. Flexible ductwork to diffusers shall have a maximum length of 6 ft.
- E. Flexible ductwork to diffusers shall be acoustic type, equal to Flexmaster 8M.
- F. Equivalent manufacturers: Flexmaster U.S.A and no others.

2.14 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Coordinate subparagraphs below with Division 23 Section "Metal Ducts." Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke] dampers according to UL listing.
- H. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch- diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.
- I. Connect ducts to duct silencers with flexible duct connectors.
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Downstream from manual volume dampers, control dampers, turning vanes, and equipment.
 - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 4. At each change in direction and at maximum 50-foot spacing.
 - 5. Upstream of turning vanes.
 - 6. Elsewhere as indicated.

- K. Install access doors with swing against duct static pressure.
- L. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 - 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 - 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 - 5. Body Access: 25 by 14 inches (635 by 355 mm).
 - 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- N. Install flexible connectors to connect ducts to equipment.
- O. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Connect terminal units to supply ducts with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.
- Q. Connect diffusers to low-pressure ducts with maximum 72-inch (1500-mm) lengths of flexible duct clamped or strapped in place.
- R. Connect flexible ducts to metal ducts with draw bands.
- S. Install duct test holes where required for testing and balancing purposes.
- T. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233416 - HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Propeller fans.
 - 2. Tubular centrifugal fans.
 - 3. Plenum fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99.
- C. Catalog rated for 15 percent greater static pressure than specified at air volume,
- D. Selected so that the specified air volume is greater than that at the apex of the fan pressure volume curve, and
- E. Selected to provide stable operation down to 85 percent of design volume operating at the required speed for the specified conditions.
- F. Brake horsepower for backward inclined bladed centrifugal fans shall not exceed 78 percent of motor nameplate horsepower times the NEMA service factor, and for forward curved bladed centrifugal fans shall not exceed 70 percent at specified duty.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Fan performance data shall be AMCA certified for sound and air performance.
- B. Fans shall be provided complete with motors and drives. Belt drive fans shall be provided with belt guards meeting OSHA requirements. Belt guards shall allow speed measurement at both fan and motor without removing guard. Each fan shall include an allowance for one pulley and belt change during balancing procedures.

- C. Provide appropriate weather covers for motors and belts where fans are exposed to weather.
- D. Fans shall be balanced statically and dynamically for maximum rated speed.
- E. Submit fan volume-pressure-horsepower curves for approval as indicated under shop drawings.
- F. Bearings shall be ball or roller anti-friction type with minimum L10 life of 160,000 hours.
- G. Where internal coating is indicated, factory apply Glidden SP24-CE double built epoxy 10 Mil to all metal surfaces including dampers, screens, curbs, in contact with air stream. Prepare steel surfaces by sandblasting per Steel Structure Painting Council Std. SP10-63 (near white). Use Type 316 stainless steel in lieu of coating at supplier's option or where required for component operation.
- H. Lubricate bearings for extended shutdown or storage and rotate shafts every four weeks until fans are put into permanent operation.
- I. Fans with motor operated dampers shall have access doors for access to both damper and motor.
- J. Drives shall be selected for a 1.5 service factor. Drives for motors over 3 horsepower shall be a minimum of two belts. Provide an allowance of one sheave change for balancing.

2.2 All belts provided with fans shall be cogged style V belts and no other.

2.3 PRESSURE RATING

- A. Refer to Division 23 Section "Metals Ducts" for component and equipment ratings. All components, equipment, and specialties, etc., shall meet the component pressure rating listed.

2.4 TYPE "D" BELT DRIVE PROPELLER FANS

- A. Belt drive sidewall type axial propeller fans equivalent to Greenheck Model SPFS for supply applications and Model SPFE for exhaust applications. Motor horsepowers and fan capacities shall be as listed on the drawings.
- B. Propeller construction shall be die formed aluminum blades riveted to a steel hub. Hubs shall be secured to fan shaft with standard square key and setscrew or tapered bushings. Propellers shall be statically and dynamically balanced.
- C. Motors shall be heavy ball bearing type.
- D. Fan shafts shall be ground and polished and shall be mounted in permanently lubricated, sealed ball bearing pillow blocks. Bearings shall be selected for a minimum life of 200,000 hours. Drives shall be sized for a minimum of 150 percent of driven horsepower. Pulleys shall be fully machined cast iron type, keyed and securely attached to the wheel and motor shaft. Motor sheaves shall be adjustable for balancing.
- E. Fan panel shall be steel construction with prepunched mounting holes, formed flanges, and a deep spun venturi. Panels shall be constructed to provide a lasting finish.

- F. Provide motor supports, vibration isolators, and OSHA fan guards. Fans shall bear the AMCA certified ratings for air performance. Provide backdraft dampers.
- G. Fans specified with 115 volt single phase motors shall be provided with speed controllers.
- H. Approved manufacturers: Loren cook, Barry, Penn Ventilator, Greenheck.

2.5 INLINE CENTRIFUGAL FANS

- A. Provide fans as scheduled on the drawings. The mfr specification for the basis of design fan shall apply as the basis of design requirements.
- B. Provide all accessories as noted on the plans and fan schedule.
- C. Fans shall include belt guard, weather cover, bolted access door, inlet flange and discharge flange as applicable.
- D. Approved manufacturers: Loren Cook, New York Blower, and Greenheck.

2.6 PLENUM FAN

- A. Fan shall be direct drive fans design for a fan array (supply fans) or single fan operation (relief fans) where noted on the drawings. The economizer relief fan shall be belt drive with the arrangement as shown on the plans.
- B. Support fan and bearing from a structural steel framework.
- C. Provide solid steel fan shaft, completely ground and polished.
- D. Provide cast iron fan hub, keyed to the shaft and locked with setscrews.
- E. Provide fully welded housings equipped with removable spun inlet cones designed for smooth airflow into the accompanying venturi shaped fan wheel inlet cone.
- F. Manufacturers: Greenheck or equivalent

2.7 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Support floor-mounting units using spring isolators. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- E. Support suspended units from structure using threaded steel rods and isolation specified. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Install units with clearances for service and maintenance.
- G. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
1. Verify that shipping, blocking, and bracing are removed.
 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 5. Adjust belt tension.
 6. Adjust damper linkages for proper damper operation.
 7. Verify lubrication for bearings and other moving parts.
 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 9. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
 10. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

- A. Train the owner's maintenance personnel to adjust, operate, and maintain centrifugal fans. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 233416

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Variable volume terminal units.

1.3 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.4 COORDINATION

- A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Unit size, capacities, and minimum and maximum settings are as indicated on the drawings. All performance data will be certified in accordance with ARI Standard 880.
- B. Terminal unit discharge sound power levels shall not exceed NC 35 in the room when delivering design cfm at 1.0 inches w.g. static pressure across the unit. Discharge sound power level indicated is based on a 10 dB room absorption, RE 10^{-12} watts and 5 feet long internally insulated discharge duct.

- C. Terminal unit radiated sound power levels shall not exceed NC 35 in the room when delivering design cfm at 1.0 inches w.g. static pressure across the unit. Sound power level indicated is based on a 10 dB room absorption, RE 10^{-12} watts and a ceiling sound transmission class 35-39.
- D. At 1.5 inches w.g. static pressure, unit casing leakage shall not exceed 1 percent of nominal terminal unit air volume for units below 800 cfm and .5 percent for remaining terminal units.

2.2 TYPE VARIABLE VOLUME TERMINAL UNIT

- A. Single duct variable or constant volume terminal unit shall be pressure independent. Maximum pressure drop for any size unit shall be the lesser of 0.20 inches w.g. static pressure or as indicated on the drawings.
- B. The construction shall be low temperature air construction type.
- C. Unit shall be complete with inlet flow sensor which shall compensate for flow conditions. Unit casings shall be galvanized steel, internal rigid fiberglass insulation which complies with NFPA-90A and UL 181; all cut edges of insulation shall be sealed from the airstream using metal brackets to meet the erosion protection requirements of NFPA-90A. Terminal unit fiberglass insulation shall be protected with foil laminated to the fiberglass.
- D. Volume regulator damper shall be heavy gauge metal with self-lubricating bearings. Damper shall have built-in stop to prevent overstroking and shall seal against a low leakage gasket.
- E. Electric/electronic controller and actuator shall be provided by the controls contractor. Pneumatic tubing shall be UL listed flame retardant (FR) type. Unit shall be capable of full shutoff. Controller shall be suitable for control sequences indicated on the drawings.
- F. Product: E.H. Price SDV 5000; Titus ESV 3000; Anemostat FA Series; and no others.

2.3 VARIABLE VOLUME REHEAT TERMINAL UNIT WITH HEATING COIL

- A. Same as paragraph 2.2 above except with hot water reheat coil with capacity as scheduled on the drawings.
- B. Coil air pressure drop shall not exceed 0.25 inches w.g. static pressure at scheduled air flow. Refer to drawing schedule. Unit shall be factory installed with casing to match terminal unit. Coil shall have copper tubes and aluminum fins.

2.4 SOURCE QUALITY CONTROL

- A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.
- B. Verification of Performance: Rate air terminal units according to ARI 880.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air terminal units to allow service and maintenance.

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.3 GENERAL

- A. Provide diffusers, registers and grilles as scheduled on the drawings and specified herein. Refer to architectural reflected ceiling plans for exact locations of diffusers, registers and grilles. Make minor modifications to ductwork as required.
- B. Diffusers, registers and grilles shall be tested and rated in an ADC Certified Laboratory in accordance with ADC requirements.

PART 2 - PRODUCTS

2.1 DIFFUSERS

- A. Diffusers shall be factory fabricated constructed of steel or aluminum and shall have fixed or adjustable air discharge pattern as indicated. Coordinate diffuser type with ceiling type.
- B. All diffusers shall be equivalent to the basis of design diffuser or grille.
- C. Refer to all notes in the diffuser schedule sheet.
- D. Approved Diffusers for Thermally Actuated Office Diffusers
 - 1. Price, Acutherm, and no others
- E. Approved Diffusers for all other Diffusers / Grilles
 - 1. Price, Titus, and no others

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. The set point adjustment on the thermally actuated diffusers when installed shall be field verified by the mfr representative to make sure that the setting matches the space set points.
- E. The mfr representative shall come to the site to inspect the installed condition for all thermally actuated diffuser installations to sign off that they are installed per the mfr requirements. This includes controls.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 234100 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.3 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air filters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 90A and NFPA 90B.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide three (3) complete sets of filters. One set shall be installed just prior to balancing but after cleaning of duct and air handling systems. The second shall be installed by the contractor on the day of building turn-over. The building flushing needs to be complete to satisfy the LEED requirement prior to the 2nd set of filters being installed. The third set of filters shall be turned over to Owner for future use. All filters should be stored off site in a protected area until just prior to the filters needing to be installed or turned over to the owner.
2. Should air handling systems be used for temporary heating during construction, provide temporary filters as required of equivalent efficiencies to those specified for permanent use in addition to the three sets required above. Temporary filters shall be replaced when the pressure drop is double the initial pressure drop with filters of equivalent efficiencies to those specified in addition to the two sets required above.
3. Provide one container of red oil for inclined manometer filter gage.

1.5 GENERAL FILTER REQUIREMENTS

- A. Filters shall be tested and rated in accordance with ASHRAE Standard 52.1-1992. Specified efficiency for filters is an average efficiency and dust holding capacity. Types A, B, C, D, E, F, and G filters shall also be tested for removal efficiency by particle size in accordance with ANSI/ASHRAE Standard 52.2-1999.
- B. Filters shall be rated as Class I or Class II in accordance with UL.
- C. Provide holding frames and fasteners suitable for upstream or downstream filter servicing as indicated on the drawings.
- D. Overall filter bank dimensions as indicated on the drawings.
- E. Provide filter gauges and air filter kits as required to indicate filter pressure differential. Gauges shall be installed by the Sheet Metal Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Refer to Division 23 for component and equipment ratings. All components, fittings, equipment, coils, specialties, etc., shall meet the component pressure rating listed.

2.2 TYPE FILTER

- A. Filters shall be high performance, extended area, deep pleated replaceable media filters.
- B. Performance Ratings
 - 1. Minimum average efficiency: MERV 8
 - 2. Minimum average arrestance: 90 percent
 - 3. Maximum initial static pressure: 0.20 inches w.g. at 500 fpm velocity
- C. Construction
 - 1. Filter Element: Filter element shall be high performance, perforated, deep pleated disposable type. The media shall be non-woven cotton fabric material with synthetic backing.
 - 2. Sealer Frames: Sealer frames shall be constructed of galvanized steel with gasket at rear for positive seal.
 - 3. Media Retainer: Media retainer shall be welded steel construction designed to support media pleats.
- D. Holding Frame
 - 1. Holding frame shall be minimum 16 gauge galvanized steel with gaskets and appropriate spring fasteners.
 - 2. Holding frame shall be factory constructed equivalent to Cam-Farr Type 8 or Flanders Type 9. Provide appropriate spring fasteners as required for intended holding frame duty. Holding frame assembly shall be permanently mounted. Frame shall be neoprene gasketed around the perimeter to properly seal the filter.
- E. Manufacturers: Cam-Farr (HP); AAF (Renu-Kleen); Flanders (Uni-Frame).

2.3 TYPE FILTER

- A. Filters shall be high performance, 12 inch deep, extended area disposable type cartridge filters.
- B. Performance Ratings
 - 1. Minimum efficiency: MERV 13
 - 2. Minimum average arrestance: 98 percent
 - 3. Maximum initial static pressure: 0.68 inches w.g. at 500 fpm velocity
- C. Construction
 - 1. Filter Media: Filter media shall be high density glass microfibers, reinforced to a backing.
 - 2. Enclosing Frame: Enclosing frame shall be constructed of galvanized steel channel. Filter media shall be secured to channel for airtight fit.
- D. Holding Frame
 - 1. Holding frame shall be minimum 16 gauge galvanized steel with gaskets and appropriate spring fasteners.
 - 2. Holding frame shall be factory constructed equivalent to Cam-Farr Type 8 or Flanders Type 9. Provide appropriate spring fasteners as required for intended holding frame duty. Holding frame assembly shall be permanently mounted. Frame shall be neoprene gasketed around the perimeter to properly seal the filter.
- E. Manufacturers: Cam-Farr (Riga-Flo); AAF (Varicel); Flanders (Rigid Air).

2.4 FILTER GAUGES

- A. Provide differential pressure magnehelic gauges for each filter bank, e.g., prefilters and final filters where in series.
- B. Gauge shall be diaphragm actuated, shall have pointer zero adjustment, two vent valves, and adjustable signal flag.
- C. Provide two static pressure taps per gauge, fittings as required and mounting accessories.
- D. Gauge range shall be compatible with filter bank served.

PART 3 - EXECUTION

3.1 HOLDING FRAMES

- A. Provide blank-off panels between holding frames and AHU casing. Blank-off panels shall be secured to AHU casing and holding frames with angles of depth and width equal to holding frame depth.
- B. Blank-off panels and angles shall be 16 gauge galvanized steel with supports as required to prevent bulging of panels during operation.
- C. Holding frames shall be riveted together with gaskets or non-hardening sealant between frames, AHU casing, blank-off angles and sheets to provide a leak-free installation.

- D. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

3.2 FILTERS AND FILTER GAUGES

- A. Filters and filter gauges shall be installed as per manufacturer's instructions including but not limited to filter frame assembly, filter mounting and gauges.

3.3 PRESSURE GAUGE

- A. Install filter gage for each filter bank.
- B. Mount differential pressure gauge next to filter change access door.
- C. Provide static pressure taps 12 inches upstream and 12 inches downstream of filters in a non-turbulent area. Set signal flag to maximum pressure differential for filter bank served.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust] field-assembled components, filter and filter-frame installation, and electrical wiring[, and to assist in field testing]. Report results in writing.
- B. Operate automatic roll filters to demonstrate compliance with requirements. Test for leakage of unfiltered air while system is operating. Correct malfunctioning units, then retest to demonstrate compliance. Remove and replace units that cannot be corrected with new units and retest.

3.5 CLEANING

- A. After completing system installation; conducting the building flush out; and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 234100

SECTION 237310 - COILS

PART 1 - GENERAL

1.1 GENERAL

- A. Water coil ratings shall be ARI certified.
- B. Coils shall be protected from damage during shipment and installation. Replace coils which have loose fins or damaged tubes.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Tubes: tubes shall be 1/2 inch or 5/8 inch copper tubes mechanically bonded to fins and expanded into cast iron headers. Minimum tube thickness: 0.025 inch.
- B. Fins: configured plate-type aluminum fins with full fin collars mechanically bonded to tubes. Minimum fin thickness: 0.0085 inch.
- C. Casings: casings shall be 16 gauge stainless steel. Provide center and end supports as required.
- D. Headers: steel, cast iron or copper headers. Steel or cast iron shall be painted with aluminum paint after fabrication. Supply and return connections shall be at the same end.
- E. Coils shall meet capacity and physical requirements as indicated on the drawings.

2.2 APPROVED MANUFACTURERS

- A. Water coils: Aerofin, Heatcraft, Marlo, Trane, McQuay, and York.

PART 3 - EXECUTION

3.1 GENERAL

- A. Level water coils as recommended by manufacturer.
- B. Provide unions and pipe coils to allow for coil removal.

END OF SECTION 237310

SECTION 237501 - RADIANT FLOOR HEATING

PART 1 - GENERAL

1.1 GENERAL

- A. Provide radiant floor heating and snow and ice melting system tubing, distribution manifolds with venting/air purge valve, manifold to tubing fittings, embeddable compression sleeve tubing repair couplings, circuit isolation and balancing valves, controls and installation specialties, supervision and field engineering required for complete and proper function of the system.

1.2 REGULATORY REQUIREMENTS

- A. Tubing shall conform to ASTM F876 and ASTM F877 and manufactured using their T. Engle process. Tubing oxygen permeation barrier shall conform to DIN 4726.
- B. Installer's Qualifications: Installers shall be qualified in writing as either being certified or certifiable prior to the commencement of the installation.

1.3 REFERENCES

- A. ASTM F876 Standard specification for Crosslinked Polyethylene (PEX) Tubing.
- B. ASTM F877 Crosslinked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems.
- C. DIN 4726 German Standard for Plastic Piping Used in Warm Water Floor Heating Systems.

1.4 SUBMITTALS

- A. Provide submittals and shop drawings in accordance with the General Requirements and as specified herein. Submit shop drawings indicating schematic layout of system, including equipment, critical dimensions and tubing/slab penetration details and details for protected exposed PEX tubing.
- B. Submit manufacturer's technical instructions.
- C. Submit installers' certifications of training for installation of PEX floor heating and snow and ice melting systems.
- D. Submit data indicating tube sizing and panel performance at tube spacing and warm water temperatures selected.
- E. Submit independent certification results for the tubing systems from a recognized testing laboratory.
- F. Submit catalog data on all supports, tube guides, spacers and associated items necessary for the installation of the tubing and manifolds.
- G. Submit design calculation record forms indicating the complete radiant floor heating.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store tubing and specialties in shipping containers with labeling in place. Do not expose to ultra violet light for more than 90 days.
- B. Protect tubing and specialties from entry of contaminating material by installing tape or plugs in all open tube ends until installation and/or maintain tubing in the original shipping boxes or packaging until usage.
- C. Unprotected tubes shall not be dragged across the ground or concrete surfaces and shall be stored on a flat surface with no sharp edges.
- D. Tube shall be protected from oil, grease, direct sunlight and other elements as recommended by manufacturer.

1.6 WARRANTY

- A. The radiant floor and snow and ice melting system component manufacturer shall warrant the crosslinked polyethylene tubing to be free from defects in material and workmanship for a period of 25 years. Warranty shall be issued upon presentation of design calculation record forms and site inspection reports. The design shall be approved either by submittal or stamped by a Registered Engineer as being complete and accurate.
- B. All controls shall be warranted for two years and two complete heating seasons.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable Manufacturers: Rehau or approved equivalent by Uponor/Wirsbo or Watts Radiant.
- B. Refer to the plans and schedules for all performance and sizing related information.

2.2 TUBING

- A. Material: All radiant floor heating tubing shall be high density cross-linked polyethylene manufactured in accordance with ASTM F877 as certified by NSF and with an approved cell classification in accordance with ASTM D3350. All tubing shall be fully cross-linked to the specified standard prior to shipment from the manufacturing facility.
- B. Temperature and Pressure Rating: Tubing shall be rated for not less than 180°F working temperature and 100 psig working pressure.
- C. Oxygen Diffusion Barrier: Tubing shall have a co-extruded oxygen diffusion barrier capable of limiting oxygen diffusion through the tube to no greater than 0.10/g/m³/day at 104°F water temperature, in accordance with DIN 4726.
- D. Bend Radius: The minimum bend radius for cold bending of the tube shall not be less than five times the outside diameter. Bends with a radius less than stated shall require the use of a bending template as supplied by the tube manufacturer.

2.3 FITTINGS

- A. Fittings shall be manufactured of brass and shall be supplied by the tubing manufacturer as part of a proven cataloged system.
- B. Tube couplings embedded within the thermal mass shall be brass compression type with ribbed insert and compression sleeve.

2.4 MANIFOLDS

- A. Material: Distribution manifolds shall be a proven cataloged part of the manufacturer's system.
- B. Balancing Manifolds: Where required by the drawings, manifolds shall be equipped with balancing and isolation valves for each circuit.

2.5 CONTROLS

- A. Provide a complete control system to comply with the requirements on M800 series drawings. The manufacture shall coordinate with the control system to map all points to the main BAS. All set points shall be adjustable through the BAS.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Concrete Slab on Grade: Subsoil shall be compacted, flat and smooth to prevent damage to tubes or insulation.
- B. Preparing the Wall Cavity for Manifold Installation: See drawings to determine the width of the wall cabinet and required wall opening dimensions. Mount the manifold cabinet allowing space for the screed to fill up the tube opening.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's published technical manual.
- B. Route tubing in orderly manner, according to layout and spacing shown in approved submittal drawings. All notes on drawings shall be followed.
- C. At joints and fittings, square and clean end of tube, using a plastic tube cutter and join immediately or cap with tape to seal from contaminants. Where fittings are installed within the thermal mass they shall be wrapped in chloride-free tape.
- D. Remove all twists prior to securing tube. Fasten tubing at no more than 3 feet intervals, being careful not to twist the tube. In thin concrete slabs it may be necessary to secure tubing every 2 feet.
- E. Tubing that must pass through expansion joints shall be sleeved 10 inches on each side of the joint.
- F. Where tubing exits the floor, a sleeve shall be placed around the tube with the sleeve extending a minimum of 10 inches into the floor and exiting by a minimum of 10 inches.

- G. After laying each circuit, cap the end of the tube with tape and label the tube's circuit numbers (supply and return) or connect to associated manifold and label tube length for balancing.
- H. The following precautions shall be taken in areas intended for carpet:
 - 1. Notify carpet installer that hydronic floor heating has been installed.
 - 2. Install metal guards where carpet tack strips will be installed.
- I. The heating system should be put into operation after the poured concrete thermal mass has cured a minimum of 28 days. If it is necessary to operate the heating system to prevent freezing, a maximum flow temperature of 59°F must not be exceeded while the thermal mass is curing. Gradually increase the flow temperature by 10°F each day until it reaches the maximum operating temperature.

3.3 FIELD QUALITY CONTROL

- A. Filling, Testing and Balancing: Tests of hydronic heating systems shall comply with local codes and, where required, shall be witnessed by the building official. (Reference BOCA, IAPMO or the acceptable code body for the geographic area.)
 - 1. Pressure gauges used must show pressure increments of 1 psig and should be located at or near the lowest points in the distribution system.
 - 2. Air Test:
 - a. Charge the completed, yet unconcealed tubes with air. Do not exceed 100 psig.
 - b. Use liquid gas detector or soap to check for leakage at manifold connections. Relieve air pressure.
 - 3. Water Test:
 - a. Charge the completed, yet unconcealed tubes with water. Purge all air from tubes. Check the system for leakage, especially at all tube joints. Take necessary precautions to prevent water from freezing.
 - b. Perform a preliminary pressure test pressurizing the system to 1.5 times the maximum operating pressure, or 100 psi, whichever is greater for 30 minutes. As the tubing expands, restore pressure, first at 10 minutes into the test and again at 20 minutes. At the end of the 30 minute preliminary test, pressure must not fall by more than 8 psig from the maximum and there shall be no leakage.
 - 4. After performing the preliminary test, perform the main pressure test immediately. The main pressure test shall last 2 hours. The test pressure should be restored and must not fall more than 3 psig after 2 hours. No leakage should be detected.
 - 5. Pressure shall be maintained during installation of the thermal mass.
 - 6. Complete all inspection and test reports as supplied by the manufacturer of the system.

END OF SECTION 237501

SECTION 238050 – CUSTOM AIR HANDLING UNIT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to this section.

1.2 GENERAL

- A. Provide air handling unit of type, quantity, and duty as indicated on the drawings. Units shall have components and sections arranged as indicated on the drawings. Units shall have components and overall dimensions as indicated on the drawings and shall fit into space available with adequate clearance for servicing.
- B. Air handling components, including but not limited to, fans, filters, coils, vibration isolation, bases, sheet metal accessories, variable frequency drives, louvers, and controls are specified elsewhere in Division 23 unless otherwise indicated.
- C. Provide an allowance of 12 hours of onsite training of college maintenance staff. The training must be coordinated with the college at least 2 weeks prior to commencement. In addition initial 8 hour training shall occur over 1 day or 2 days at the owner's preference. The additional 4 hours training shall be reserved for a period of at least 1 month after the initial training.
- D. The general requirements for the components sections shall apply.
- E. Submit for review pressure, volume and horsepower curves and sound power information for each unit fan in addition to all other performance data. Fan performance data shall be AMCA certified. Fan selections shall include the following criteria:
 - 1. Catalog rated for 15 percent greater static pressure than specified at air volume,
 - 2. Selected so that the specified air volume is greater than that at the apex of the fan pressure volume curve..
 - 3. Selected to provide stable operation down to 85 percent of design volume operating at the required speed for the specified conditions.
- F. Provide an allowance for one sheave and one belt change for each air handling unit during balancing procedures.
- G. Construction of air handling components including but not limited to intake plenums, discharge plenums, and access sections shall be the same construction as the air handling unit casing.
- H. As minimum, all components inside of the AHU and the AHU wall construction shall be rated for the shut off head pressure of the fan.
- I. Piping required internal to the air handling unit shall be factory installed up to the exterior of the unit. Termination shall be capped flanged connections for piping over 2 ½" and capped threaded connections for piping below 2 ½". All unit penetrations shall be made at the factory. Piping internal to the unit shall be insulated per the insulation specifications.

- J. Submit overall sound information including discharge and radiated sound levels for each air handling unit.
- K. Prior to startup, the installing contractor shall provide final cleaning of all air handling units (both interior and exterior of the unit). The air stream of the unit shall be oil and grease free and wiped clean with 50-50 mix of isopropyl alcohol and water.
- L. Openings in floors shall be protected with galvanized metal grating with nominal 80 percent free area. Grating shall be suitable for foot traffic.
- M. AHU construction shall apply for entire prefabricated AHU/Mechanical penthouse located on roof.
- N. The custom penthouse manufacturer shall provide all equipment (mechanical, plumbing, and electrical) shown in the custom penthouse unless noted otherwise. Refer to the plumbing and electrical specifications and drawings for scope of work.
- O. Drawing M401 shows the layout for the custom penthouse. The schedules for all mechanical equipment are located on M700 series drawings. However all mechanical drawings and specifications are required to be reviewed for project requirements that are included within the scope of work of this specification.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Refer to Section 237000 for component and equipment ratings. All components, fittings, equipment, coils, specialties, etc., shall meet the component pressure rating listed.
- B. Curbs
 - 1. The manufacturer shall furnish the curb for the custom penthouse AHU.

2.2 Electrical Requirements

- A. The custom penthouse is a single point(s) connection with the electrical scope within the unit provided by the custom penthouse manufacturer.
- B. Refer to drawing M401, all electrical specifications and the electrical drawings for requirements
- C. Multiple Manufacturers
 - 1. Where multiple manufacturers of major components (that are located in the scope of the custom penthouse and elsewhere in the building), the manufacturer selected by the electrical contractor shall be used. If required, provide multiple line items in the bid sheet for all possible manufacturers to provide the same manufacturer.

2.3 Plumbing Requirements

- A. The plumbing contractor is responsible for bringing the water mains through the floor. All other piping will be by the custom penthouse / AHU manufacturer.
- B. Refer to drawing M401, all plumbing specifications and the plumbing drawings for requirements

2.4 CUSTOM BUILT, FACTORY ASSEMBLED OUTDOOR-MOUNTED AIR HANDLING UNITS

- A. Air handling units shall be custom-built type.
- B. The unit shall have stairs and a platform on the exterior of the unit. The stairs and platforms shall be by the G.C. An outdoor light above the outdoor platform shall be provided and wired by the custom penthouse manufacturer.
- C. Units shall be factory assembled in the unit manufacturer's plant. Units shall be assembled complete with components arranged as indicated on the drawings and described herein. Components shall be enclosed in casings constructed of insulated double walled panels.
- D. AHU module drains
 - 1. All drains from the air handling unit modules (except the cooling coil drain pan) shall be piped together in the floor of the unit and exit the side of the unit with a trap. The drain shall be extended to the edge of the roof to the gutter system.
- E. Unit penetrations
 - 1. All penetrations of the unit shall be by the custom penthouse mfr unless noted otherwise on the plans (for example the heat recovery piping will required a chase to be sealed by the mechanical contractor).
- F. Unit Construction
 - 1. Unit Base
 - a. Each unit shall be constructed on a fully welded structural steel base. The base shall be braced to support internal components and equipment maintenance personnel without sagging or pulsating. Minimum floor thickness 3/16" aluminum treadplate welded to the channel base and intermediate supports. The individual

treadplate sections shall be welding together where multiple sections are used and at the shipping splits.

- b. Entire unit base shall be minimum 2 inches deep waterproofed drain pan. One side of the unit shall have a side drain. Cooling coil drain shall have IAQ sloped drain pan of 12 gauge welded stainless steel.
- c. The unit base perimeter shall have a channel continuously welded to the floor for support. Channel shall be minimum 6 inches deep.
- d. The base underside shall be insulated with 4 inches of foam insulation. The sides shall be insulated and flashed. The insulation shall be secured with weld pins. The underside of the insulation shall be protected with a 20 gauge sheet metal closure panel.
- e. In base sections normally wet, including but not limited to cooling coil sections, provide a galvanized steel grating above the normal water line. Grating shall be removable for easy access to unit floor.
- f. Bases shall incorporate lifting lugs, minimum four (4) per modular section.
- g. Base shall be painted with epoxy mastic.

2. Casing

- a. Wall and roof casing panels shall be double wall construction with 14 gauge galvanized steel face sheets, minimum 2 inch thick foam insulation with a minimum effective thermal conductivity R of 8.0 BTU /hr sq.ft. °F. (the equivalent fiberglass insulation with a vapor barrier may be provide inlieu of foam insulation if approved via the substitution request process as defined in Division 1). Insulated panels shall meet UL 181 erosion requirements and NFP 90A for flame spread and smoke generation. Provide 4 inch thick foam panel insulation in the cooling coil section and downstream throughout the unit height and width.
- b. Outer wall and roof panels shall be constructed of Centria IW-10A, color as selected by the architect. Each panel shall have an integral frame bonded to face sheets to provide an air and watertight fit at the panel perimeter. All fasteners shall be gasketed. Panels shall be load bearing. Panel system shall incorporate a thermal break to eliminate through metal paths between the interior and exterior surfaces including but not limited to frames, mullions, and corners.
- c. Casing panels, including blank-off panels and panels separating fan, fan suction and discharge shall be assembled and spaced to eliminate panel pulsation and limit the maximum deflection to 1/200 of any span at design load of 1-1/2 times the design positive or negative static pressure.
- d. Panels shall have true "No Thru Metal" construction. A formed hat channel of a non conducting extruded composite, such as CPVC or Lexan shall be installed on the exterior of the inner liner and shall run horizontal around the unit. The hat channels will be installed, at a minimum, at the top, midpoint and bottom of the wall. The standing seam siding will attach to these hat channels. Thermal break gasketing will not be accepted as a "No Thru Metal" design.
- e. If the manufacturer's wall construction detail can not meet the requirements above with the specified Centria panel as the outer wall, an exterior hat channel shall be provided. The centria panel shall be mounted to this channel.
- f. Internally baffle or blank-off to prevent bypass of air around fan sections, coil sections, etc.

- g. Each unit section shall have an access door. Minimum size shall be 2 feet wide by 6 feet high or full size of casing section, whichever is smaller. Doors shall open against the section's air pressure with the hinge toward the fan. Air infiltration shall be limited to 0.41 CFM per linear foot of frame at 11 inches WG static pressure. Provide removable panels at coils, fan sections, and where indicated on drawings and specified herein. Access doors and removable panels shall be double sealed and guaranteed tight. Each access door shall have a window. Access door windows downstream of cooling coil shall be double pane. Access doors shall be mounted with a corrosion resistant continuous piano hinge and shall have a minimum of two operable handles. Door handles and latches shall be metal. Plastic or composite handles will be rejected.
 - h. Each AHU access section shall have a permanent, re-sealable test port. The ports shall extend through the double wall construction with a tight seal per unit construction standards.
 - i. Casing shall be rated for the sound transmission loss rating in dB in accordance with ASTM E413-73.
 - 1) Frequency-Hz 125 250 500 1,000 2,000 4,000
 - 2) Transmission Loss-dB 21 25 34 44 51 53
 - 3) Testing must be documented by an independent acoustical laboratory.
 - j. Field joints for modules shall be inside flanged with alignment guides.
 - k. Galvanized panels shall be G90 steel sheet for unpainted and G60 galvanized steel for painted units.
3. Roof
- a. AHU roof shall be sloped for proper drainage of snow and rain. Provide gutter system above doors.

G. Outdoor Air Section

- 1. Louvers shall be storm louvers with a 47% free area. Refer to specification section 238650.
- 2. The unit module shall have grating above drain pan.
- 3. Outside air dampers shall be provided to modulate the flow of outside air. Dampers shall be equivalent to Ruskin CD-60 opposed blade damper. Blades shall be 14 gauge galvanized steel, airfoil shape. Frames shall be 16 gauge galvanized steel hat channel. Axles shall be ½ inch diameter plated steel with outboard support bearing or jackshaft as required for damper size. Damper pressure drop shall not exceed 0.15 inch static pressure w.g. at 2,000 fpm face velocity. Leakage shall not exceed 4 cfm at 4 inch static pressure w.g. for a 2 foot x 2 foot damper. Bearings shall be heavy-duty, self-lubricated nylon. Damper blades shall have neoprene rubber seals. Jams shall have flexible metal compression jams.
- 4. Refer to drawing M401 for additional requirements.

H. Filter Sections

1. Provide final filter and pre-filter sections with holding frames complete with two sets of filters. Material to match unit construction. Size, type and quantity as scheduled on the drawings. See Section 234100 for filter specifications.
2. Unit manufacturer shall provide a pressure gauge for indication of filter pressure drop. See Section 234100 for pressure gauge specification.
3. Refer to drawing M401 for additional requirements.

I. Fan Sections

1. Supply fan section shall have six direct drive plenum fans as scheduled in a fan array configuration. The fans shall be direct drive plenum fans by Greenheck or equivalent. See Division 23 specifications for other fan requirements. The fan and motor shall be factory mounted on a spring inertia type vibration base. Base shall have an internal adjustable motor base.
2. Unit shall be provided with a factory-mounted flexible connection between fan and discharge wall.
3. Provide a blank off panel for the intake side of the fan section so that a failed fan can be isolated manually. All fans shall be configured to allow a blank off panel to be installed. Provide (2) blank off panels with the unit.
4. Refer to drawing M401 for additional requirements.

J. Preheat Coil Section

1. Provide preheat coil section with coil capacity as indicated on the drawings. See Section 237310 for coil specification. Coil section shall have an aluminum coil rack supporting each coil, airtight baffle. Coil rack shall allow any one coil to be removed through the unit casing normal to the directions of air flow without disturbing any other coil. Provide removable access panel on each side of the preheat coil section.
2. Coil headers shall be factory pre-piped, pre-insulated, and extend to the exterior of the unit casing. Provide unions in piping for coil removal.
3. Provide Aluminum integral floor drain pan.
4. Provide bypass damper.
5. Refer to drawing M401 for additional requirements.

K. Cooling Coil Section

1. Provide cooling coil section with coil capacity as indicated on the drawings. See Section 237310 for coil specification. Coil section shall have a stainless steel coil rack supporting each coil, insulated airtight baffle, and condensate drain pan for each coil. Each drain pan shall be individually piped to the air handling unit drain pan which shall be an aluminum integral drain pan slope to the unit discharge.
2. Drain pan shall be 16 gauge S.S. IAQ sloped and shall extend a minimum of 2 inches upstream and extend a minimum of 9 inches downstream from the face of the cooling coil.

3. Coil rack shall allow any one coil to be removed through the unit casing normal to the direction of air flow without disturbing any other coil. Provide removable access panel on each side of cooling coil section.
4. Coil headers shall be factory pre-piped, pre-insulated, and extend to the exterior of the unit casing. Provide unions in piping for coil removal.
5. Refer to drawing M401 for additional requirements.

L. Discharge Plenum

1. Smoke/Isolation dampers shall individually isolate each air handling unit. Refer to specification section 233300.
2. Refer to drawing M401 for additional requirements.
3. Discharge section shall be complete with spun bell mouth fitting conforming to the size and configuration of the ductwork.

M. Refer to drawing M-401 for all other section information.

N. Service Corridor

1. Provide service corridor as shown and dimensioned on drawings.
2. Service corridor shall be provided with accessible sections to permit the installation and service of piping below unit.
3. Service corridor flooring shall be 3/16" aluminum treadplate.
4. Lights and convenience outlets shall be provided as noted on the drawings. Interior lights shall be fluorescent type.
5. Refer to drawing M401 for additional requirements.

O. Plumbing Floor Drains/Sleeves Penetrations

1. Provide plumbing floor drawings and sleeve penetrations as indicated on the drawings.
2. Refer to div 22 specifications.
3. Refer to drawing M401 for additional requirements.

P. Electrical Requirements

1. General
 - a. Electrical work shall conform to the latest National Electrical Code.
 - b. Unit manufacturer shall provide electrical work listed below. Each shipped section shall be prepiped and prewired to one identified feed location on the outside of the unit casing.
 - c. Wiring shall be in conduit with copper wire.

2. Light Fixtures

- a. Light fixtures shall be equivalent to RAB, VX100DG, vapor tight incandescent marine type guarded service light fixture, 100 watts each, (A-21) R.S. bulb.
- b. Each section shall have two (2) light fixtures.

3. Light Switches

- a. Light switches shall be equivalent to Pass and Seymour #15AC1-RPL single-pole, with pilot-lighted switch, bell box with stainless steel cover plate.
- b. Each section shall have a light switch on exterior of casing located beside non-hinged side of access door.

4. Electrical Outlets

- a. Electric outlets shall be equivalent to Bryant #5252 quad receptacle with #271-L bell box with #245 duplex snap cover (waterproof).

Q. Factory Testing - Air Handling Units

1. Factory run test the complete unit as an assembly to insure structural integrity and design suitability under simulated operating conditions. Unit shall be completely bolted together. The factory run test shall be conducted to examine unit operation as a system and minimum vibration levels as specified.
2. The mfr shall provide all travel expenses (hotel, food, air travel, ect) for (2) personnel to represent the owner at the factory testing.
3. Assemble unit at the factory. Operate, inspect, and determine compliance with the specifications. Correct deviations found and retest.
4. The following tests shall be performed:
 - a. Hydrostatic pressure tests on water coils and systems. Pressure shall be 120 percent of working pressure maintained for four hours.
 - b. Conduct an air pressure test with the fans operating to insure tight housing construction and integrity. The positive pressure side of the unit casing shall be positively pressurized to the shutoff head capacity of the supply fans and shall be inspected for leaks or distortion. Visible distortion shall be corrected and leakage detected shall be stopped by sealing. The negative side casing shall be negatively pressurized to the shutoff head capacity of the supply fans and shall be inspected for leaks and distortion. Correct as above. Maximum casing leakage shall be 1 percent of total air handling unit supply volume at design pressure.
 - c. Unit operation and vibration analysis. Operate the unit fan at the unit design rpm, with the fan drive set. Provide a complete vibration spectrum. Bring fan, motor, drive, and base assembly vibration to within manufacturers' acceptable levels. Motor and drive vibration must be checked with the fan installed as a total assembly.
 - d. Energize electrical devices as components to insure operational integrity prior to the unit shipment. Replace non-functional items and certify, in writing, that such replacements have been undertaken and are in proper operational order.
 - e. Submit unit housing panel acoustical performance test prior to unit shipment.

- f. Submit unit housing physical properties test data prior to unit shipment. The test data report, conducted and certified by an acceptable independent laboratory using the applicable ASTM methods, shall be incorporated into each set of the Operating and Maintenance Manual.
 - g. Provide deflection testing of casing panels to verify performance in accordance with performance requirements.
 - h. Conduct airflow tests on the supply and return, outside, airstreams at the rated design airflow pressure condition under normal and economizer modes. Conduct test procedures for airflow in accordance with the recommendations of AMCA Standard 210. The system design static pressure shall be simulated by employing a suitable transition and appropriate duct length with a variable plug. Submit a detailed system airflow test plan to the Architect for his review prior to conducting the factory test. The unit will need to be elevated high enough off of the ground to simulate the bottom discharge and intake for the unit. Electrical power shall be metered during the test.
 - i. Submit a report and incorporate into operating and maintenance manual all tests outlined above.
 - j. Unit Start-Up: After equipment installation is complete, provide a factory trained service engineer to inspect the installation and supervise the startup and checkout of the equipment. Provide tools and test equipment required to conduct the startup and checkout.
- R. Approved Manufacturers: TMI (basis of design), or approved equivalent units by Buffalo Air [no others are approved]

PART 3 – EXECUTION

3.1 GENERAL

- A. Site assemble the unit sections.
- B. Adjust fan speeds to handle the air quantity listed on the drawings.
- C. Operate the unit through control sequences and measure outlet temperatures to verify proper operation.
- D. Measure fan motor current draw to verify that motor is not overloaded.
- E. All part-3 requirements for all specifications reference in this scope of work.
- F. Factory representatives shall be used to start-up the units.

END OF SECTION 238050

SECTION 238126 - DUCTLESS SPLIT SYSTEM AIR CONDITIONING/HEAT PUMP UNITS

PART 1 – GENERAL

1.1 GENERAL

- A. Provide air conditioning/heat pump units as shown on drawings and specified herein.
- B. The air conditioning/heat pump units shall be the ductless split system type consisting of compact ceiling or wall mounted packaged fan coil sections and outdoor air-cooled condensing/heat pump sections.
- C. Units shall be rated per ARI Standards 210/240 and listed in the ARI directory as matched systems.
- D. Units shall be constructed in accordance with UL standards and shall be UL certified.
- E. Unit construction shall comply with ANSI/ASHRAE 15, latest revision.
- F. All power and control wiring shall be installed per NEC and all local building codes.
- G. The units shall have complete manufacturer's warranty for a period of one (1) year from the date of installation. The compressors shall have an extended warranty of five (5) years from the date of installation
- H. Provide 4 hours of training by factory representative for college maintenance staff. Training shall be coordinated at least 2 weeks prior to commencement with the owner.
- I. The ductless split system air conditioning/heat pump units shall be as manufactured by Daikin, Mitsubishi, or Sanyo

PART 2 – PRODUCTS

2.1 INDOOR WALL MOUNTED FAN COIL UNITS (AC)

- A. General:
 - The unit shall be wall-mounted indoor unit section with a slim silhouette and shall have a modulating linear expansion device. Refer to the unit schedule on the 700 series schedule sheet for the specific unit type.
- B. Indoor Unit
 - The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet:
 - 1. The casing shall have a white finish.
 - 2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
 - 3. There shall be a separate back plate which secures the unit firmly to the wall.
- D. Fan:

1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
 2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
 3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
 4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.
- E. Filter:
1. Return air shall be filtered by means of an easily removable, washable filter.
- F. Coil:
- The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. Both refrigerant lines to the PKFY indoor units shall be insulated.
- G. Condensate pumps shall remove condensate from the drain pans when gravity drainage cannot be used. Pumps shall be designed for quiet operation. Pumps shall consist of two parts: an internal reservoir/sensor assembly, and a remote sound-shielded pump assembly. The lift capability of the condensate pumps shall be 1 to 10 feet (3/4 ton size) and 3 to 25 feet (1 to 2 ton sizes). Level sensors on the condensate pans shall stop cooling operation if unacceptable water levels are sensed.
- H. Electrical:
1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
 2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)
 3. Power and control wiring shall have terminal block connections.
- I. The controls shall consist of a microprocessor based control system which shall control space temperature, determine optimum fan speed, and run self diagnostics. The temperature control range shall be from 64°F to 84°F. The units shall have the following functions as a minimum
1. An automatic restart after power failure at the same operating conditions as at failure.
 2. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.
 3. Temperature sensing controls shall sense return air temperature and indoor coil discharge air temperature. High discharge air temperature shutdown shall be provided.
 4. Indoor coil freeze protection.
 5. Wireless infrared remote control to enter and display set points and operating conditions.
 6. Auto Stop features shall have integral setback control.
 7. Automatic air-sweep control to provide on/off activation of air-sweep louvers.
 8. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.

9. Fan only operation to provide room air circulation when no cooling is required.
10. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit and at the remote controller.
11. Indoor-to-outdoor thermister connection cables shall be provided with the fan coil units.
12. Fan speed control shall be user selectable: high, medium, low or microprocessor automatic operation during all operating modes.
13. A time delay shall prevent compressor restart in less than 3 minutes.
14. Automatic heating-to-cooling changeover to provide automatic heating and cooling operation. Control shall include deadband to prevent rapid mode cycling (heat pumps only).
15. Demand defrost shall be provided and shall minimize defrost cycles by internally adjusting defrost timing based on frost accumulation (heat pumps only).
16. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode (heat pumps only).

2.2 INDOOR WALL MOUNTED FAN COIL UNITS (AC)

- A. Units shall be complete with cooling/heating direct expansion coils, fans, fan motors, piping connectors, wiring, electrical controls, microprocessor control systems, and integral temperature sensing. Units shall be furnished with integral wall mounting brackets, mounting hardware and thermistor interconnection cables.
- B. Unit cabinets with discharge and inlet grilles shall be architecturally styled, high impact polystyrene. Cabinets shall be fully insulated for improved thermal and acoustic performance.
- C. Fans:
 1. Fans shall be tangential direct-drive blower type with air intake at the upper front face of the units and discharge at the bottom front. Fans shall be statically and dynamically balanced.
 2. Fan motors shall be open drip-proof, permanently lubricated ball bearing type with inherent overload protection. Fan motors shall be 3-speed.
- D. Units shall include an adjustable air outlet system. Automatic, motor driven, vertical air sweep operation shall be provided as standard. The air sweep operation shall be user selectable. The horizontal direction may be adjusted using the infrared remote controller and vertical direction may be manually set.
- E. The coils shall be of nonferrous construction with aluminum plate fins mechanically bonded to copper tubing and mounted in galvanized steel tube sheets. The coils shall be pressure tested at the factory.
- F. Drip pans under the coils and piping shall have drain connections for hose attachments to remove condensate. Condensate pans shall have internal traps and auxiliary drip pans under the coil headers.
- G. Condensate pumps shall remove condensate from the drain pans when gravity drainage cannot be used. Pumps shall be designed for quiet operation. Pumps shall consist of two parts: an internal reservoir/sensor assembly, and a remote sound-shielded pump assembly. The lift capability of the condensate pumps shall be 1 to 10 feet (3/4 ton size) and 3 to 25 feet (1 to 2

ton sizes). Level sensors on the condensate pans shall stop cooling operation if unacceptable water levels are sensed.

- H. The controls shall consist of a microprocessor based control system which shall control space temperature, determine optimum fan speed, and run self diagnostics. The temperature control range shall be from 64°F to 84°F. The units shall have the following functions as a minimum
1. An automatic restart after power failure at the same operating conditions as at failure.
 2. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.
 3. Temperature sensing controls shall sense return air temperature and indoor coil discharge air temperature. High discharge air temperature shutdown shall be provided.
 4. Indoor coil freeze protection.
 5. Wireless infrared remote control to enter and display set points and operating conditions.
 6. Auto Stop features shall have integral setback control.
 7. Automatic air-sweep control to provide on/off activation of air-sweep louvers.
 8. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.
 9. Fan only operation to provide room air circulation when no cooling is required.
 10. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit and at the remote controller.
 11. Indoor-to-outdoor thermister connection cables shall be provided with the fan coil units.
 12. Fan speed control shall be user selectable: high, medium, low or microprocessor automatic operation during all operating modes.
 13. A time delay shall prevent compressor restart in less than 3 minutes.
 14. Automatic heating-to-cooling changeover to provide automatic heating and cooling operation. Control shall include deadband to prevent rapid mode cycling (heat pumps only).
 15. Demand defrost shall be provided and shall minimize defrost cycles by internally adjusting defrost timing based on frost accumulation (heat pumps only).
 16. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode (heat pumps only).
- I. Units shall have filter tracks with factory supplied cleanable filters or throwaway filters.
- J. Unit electrical requirements shall be as indicated on the drawings. Power and control wiring shall have terminal block connections.
- K. All units shall have rotatable refrigerant lines for penetration through walls using flare connections. All units shall have flare connections.

2.3 OUTDOOR AIR-COOLED CONDENSING/HEAT PUMP UNITS (ACC)

A. General:

The Y-Series shall consist of the PUHY-P-TGMU outdoor unit, indoor units (-E models), and M-NET DDC (Direct Digital Controls). The Y-Series PUHY outdoor unit shall be specifically used with CITY MULTI VRFZ components. The PUHY outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. The outdoor unit shall have a powder coated finish. The

- outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
1. The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of outdoor rated capacity.
 2. Outdoor unit shall have a sound rating no higher than 63 dB(A).
 3. Both refrigerant lines from the outdoor unit to indoor units shall be insulated.
 4. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
 5. The outdoor unit shall have a high pressure safety switch, over-current protection and DC bus protection.
 6. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have a total refrigerant tubing length of 984 feet. The greatest length is not to exceed 492 feet between the outdoor unit and the indoor units without the need for line size changes or traps.
 7. The outdoor unit shall be capable of operating in heating at -4°F ambient temperature without additional low ambient controls.
 8. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
- B. Unit Cabinet:
1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.
- C. Fan:
1. The outdoor unit shall be furnished with one direct drive, variable speed propeller type fan.
 2. The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
 3. The fan motor shall be mounted for quiet operation.
 4. The fan shall be provided with a raised guard to prevent contact with moving parts.
 5. The outdoor unit shall have vertical discharge airflow.
- D. Refrigerant
1. R410A refrigerant
- E. Coil:
1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
 2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
 3. The coil shall be protected with an integral metal guard.
 4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
 5. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.
- F. Compressor:
1. The outdoor units shall be equipped with one inverter driven scroll hermetic compressor.
 2. A crankcase heater(s) shall be factory mounted on the compressor(s).
 3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable down to 16% of rated capacity.
 4. The compressor shall be equipped with an internal thermal overload.
 5. The compressor shall be mounted to avoid the transmission of vibration.
- G. Electrical:
1. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz.

2. The unit shall be capable of satisfactory operation within voltage limitations of 187-228 volts (208V/60Hz)
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, non-polar twisted pair shielded cable to provide total integration of the system.

2.4 OUTDOOR AIR-COOLED CONDENSING/HEAT PUMP UNITS (ACC)

- A. Outdoor units shall be factory assembled, single piece, air-cooled equipment. Units shall include all factory wiring, piping, controls, compressors, full refrigerant charges and appurtenances required for a complete package.
- B. Unit casings:
 1. Unit casings shall be constructed of galvanized steel, bonderized and coated with a baked enamel finish.
 2. Unit access panels shall be removable with minimum screws and shall provide full access to the compressors, fans, and control components.
 3. The outdoor compartments shall be isolated and have an acoustic lining to assure quiet operation.
- C. Outdoor Fans:
 1. Fans shall be direct-drive propeller type arranged to discharge air horizontally.
 2. Fans shall be provided with raised metal guards to prevent contact with moving parts.
 3. Fan motors shall be totally-enclosed, single-phase motors with class B insulation and permanently lubricated sleeve bearings. Motors shall be protected by internal thermal overload protection. Motors shall be resiliently mounted for quiet operation.
 4. Fan blades and shafts shall be corrosion resistant.
 5. Fans shall be statically and dynamically balanced.
- D. Compressors:
 1. Compressors shall be fully hermetic reciprocating or scroll type.
 2. Compressors shall be equipped with oil systems, operating oil charges, and motors. Internal overloads shall protect the compressors from overtemperature and overcurrent. Scroll compressors shall also have high discharge gas temperature protection.
 3. Motors shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere.
 4. Compressors shall be equipped with crankcase heaters to minimize liquid refrigerant accumulation in compressors during shutdown and to prevent refrigerant dilution of oil.
 5. Compressor assemblies shall be installed on rubber vibration isolators and shall have internal spring isolation.
- E. Outdoor coils shall be of nonferrous construction with aluminum fins mechanically bonded to internally enhanced, seamless copper tubes which are cleaned, dehydrated, and sealed. The coils shall be protected with integral metal guards. Coils shall be leak tested at 350 psig air pressure with the coil submerged in water.

- F. Refrigerant circuit components shall include brass external liquid line service valves with service gage port connections, suction line service valves with service gage port connections, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, accumulators, bi-flow filter driers, pressure reliefs, reversing valves (heat pumps only) and heating mode metering devices (heat pumps only).
- G. Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:
1. Controls:
 - a. Time delay restart to prevent compressor reverse rotation (single-phase scroll compressors only).
 - b. Automatic restart on power failure.
 - c. Safety lockout if any outdoor unit safety is open.
 - d. A time delay control sequence is also provided standard through the fan coil board, thermostat, or controller.
 - e. High pressure and liquid line low pressure switches.
 - f. Automatic outdoor fan motor protection.
 - g. Start capacitor and relay (single phase reciprocating compressors only).
 - h. An electronically operated liquid solenoid shutoff valve shall close and open in response to compressor operation.
 - i. Low ambient control shall regulate fan-motor cycles in response to saturated condensing pressure of the unit. The control shall be capable of maintaining a condensing temperature of $100^{\circ}\text{F} \pm 10^{\circ}\text{F}$ with outdoor temperatures of -20°F .
 - j. Winter start control shall permit start-up for cooling operation under low-load conditions and at low-ambient temperatures by bypassing the low pressure switch for a 3-minute delay period.
 2. Safeties:
 - a. System diagnostics.
 - b. Compressor motor current and temperature overload protection.
 - c. High pressure relief.
 - d. Outdoor fan failure protection.
- H. Refrigerant
1. R410A refrigerant
- I. Electrical Requirements:
1. Unit electrical requirements shall be as indicated on the drawings.
 2. Unit electrical power shall be single point connections.
 3. Unit control voltage to the indoor units shall be 24 volt.
 4. Power and control wiring shall have terminal block connections.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install system in strict accordance with manufacturer's recommendations.
- B. Provide controls, including wiring, as shown on the drawings and specified herein.
- C. Place unit in operation and verify proper operation and air quantities.

END OF SECTION 238126

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Type "A" hot water unit heaters.
 - 2. Type "E" cabinet heaters.

1.3 SUBMITTALS

- A. Color Samples for Selection by Architect: Finish colors for units with factory-applied color finishes. Manufacturer shall offer a minimum of five standard colors. If five standard colors are not available, custom painting shall be provided.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 GENERAL

- A. Provide unit heaters as shown on the drawings and specified herein. The unit heaters shall have the heating capacities indicated on the drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Refer to Division 23 Piping specification sections for component and equipment ratings. All components, fittings, equipment, coils, specialties, etc., shall meet the components pressure rating listed.

2.2 TYPE "A" HOT WATER UNIT HEATER

- A. Hot water unit heaters shall have steel casings, phosphatized to prevent corrosion, and painted with baked enamel. Coils shall have aluminum fins mechanically bonded to seamless copper tubing. Fan motors shall be totally enclosed with built-in thermal overload protection. Hot water unit heaters shall be horizontal discharge propeller type. Unit shall have equipment mounted thermostat.
- B. Acceptable Manufacturers
 1. Sterling.
 2. Vulcan
 3. Dunham-Bush

2.3 TYPE "E" CABINET HEATERS

- A. All heating water coils, control valves, shut-off valves, etc., shall have a working pressure of 125 psig. All steam coils, control valves, etc., shall have a working pressure of 75 psig.
- B. Electrical
 1. Motor cords shall be quickly detachable at switch box by locking pronged connector.
 2. Units shall include step-down transformer.
- C. Controls
 1. Two-way modulating electric motorized valves shall be furnished by the DDC Manufacturer. Valves shall be field installed under this Division. Valves shall be installed remote from fan coil unit.
 2. Horizontal units shall have remote thermostat and fan speed controller.
 3. Vertical units shall have integral thermostat and fan speed controller.
- D. Coils
 1. Water coils shall be 5/8 inch O.D. copper tubes and bends.
 2. Steam coils shall be 1 inch O.D. copper tubes and bends.
 3. Heating coils shall be hot water with capacities as indicated on the drawings.
 4. Electric coils shall be sheathed finned tubular design with capacities as indicated on the drawings.
- E. Fans
 1. Fan wheels shall be centrifugal forward-curved and double-width. Fan wheels and housings shall be corrosion resistant. Fan housings shall be of formed sheet metal.
 2. Motors shall have integral overload protection. Motors shall operate satisfactorily at 90 percent of rated voltage on all speed settings and at 10 percent overvoltage without undue magnetic noise.
 3. Motors shall be factory run tested in assembled unit prior to shipping.
- F. Cabinet Finish
 1. Cabinet parts shall be cleaned, bonderized, phosphatized, and painted with enamel finish. Color selected by Architect from standard color chart.

G. Basic Unit Construction

1. Vertical units shall include chassis, coil, heavy-density, faced-glass fiber insulation, air blockoffs around coil, removable fan board, fan(s), fan housing(s), motor, and filter. Chassis of galvanized steel with flanged edges.
2. Horizontal units shall include coil, sleeved coil end supports, main drain pan, fan board, fan(s), fan housing(s), motor, thermal insulation, and filter rack.

H. Cabinet Construction

1. Vertical cabinets shall be 18-gauge steel panels with 16-gauge front panels. Front and end panels have channel-formed edges around entire perimeter. Front panels have faced, heavy-density thermal and acoustical insulation over entire coil section. (Front panels removable without tools.) End panels removable.
2. Horizontal cabinets shall be 18-gauge steel with channel-formed panel edges. Hinged, bottom access panel held closed by cam lock fasteners. Stamped integral discharge grilles on front of cabinet.
3. Horizontal recessed cabinets shall have a bottom panel of 18-gauge steel, shipped mounted to the unit.

I. Accessories

1. Provide unit levelers.
2. Provide sub-base.

J. Cabinet Style

1. Refer to the schedule and the architectural drawings for cabinet style / type.

K. Acceptable Manufacturers

1. Sterling
2. Dunham-Bush
3. Airtherm

PART 3 - EXECUTION

3.1 GENERAL

- A. Mount thermostat. Provide wiring to thermostat.
- B. Place equipment into operation and check for proper operation of fan and controls.

END OF SECTION 238239

SECTION 238650 – PENTHOUSE / AHU LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections, apply to this section.

1.2 SUMMARY

- A. This section only pertains to the Penthouse / Air Handling Unit louvers. Penthouse / AHU louvers shall be provided by the custom unit manufacturer. All louvers in architectural walls are specified elsewhere and shall be furnished and installed by the G.C. This requirement is so that a complete wall assembly is provided by one contractor who is then completely responsible for the “wall” construction. Refer to the architectural and mechanical plans for louver sizes.
- B. Section Includes:
 - 1. Penthouse Fixed wall louvers.
 - 2. Penthouse Accessories.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Requirements: Design louvers to safely withstand dead load and live loads prescribed by governing building code.
- B. Thermal Movement: Design to accommodate expansion and contraction resulting from normal air temperature range of minus 20 to plus 110 degrees F, solar heat gain, and nighttime re-radiation without buckling, undue stress on structural elements, reduction of performance, or other detrimental effects.

1.4 SUBMITTALS

- A. Product Data.
- B. Wall Louvers: Louver size, louver type, and material.
- C. Shop Drawings: Show elevations, field measurements (if applicable), reinforcement, anchorages, and expansion provisions.
 - 1. Include air supply and pressure drop information.
- D. Structural Calculations: Submit, for information only, calculations prepared and signed by a registered professional engineer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A company designing, manufacturing, and installing products of this section which have performed in a satisfactory manner under comparable conditions for a period of 5 years.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Where conditions permit, take field measurements and determine actual installed positions of louvers before beginning louver fabrication.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
- D. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
 - 1. Horizontal Mullions: Provide horizontal mullions at joints.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: as required to obtain appearance indicated on the drawings.
- E. Include supports, anchorages, and accessories required for complete assembly.

- F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.
 - 1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
 - 2. Exterior Corners: Prefabricated corner units if required shall be constructed with mitered blades with concealed close-fitting splices and with fully recessed mullions at corners.
- G. Provide subsills or extended sills for recessed louvers made of same material as louvers.
- H. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal Storm-Resistant Louver
 - 1. Basis-of-Design Product:
 - a. Ruskin Company
 - 2. Louver Depth: 6 inches.
 - 3. Frame and Blade Nominal Thickness: Not less than [0.080 inch (2.03 mm)] [0.060 inch (1.52 mm) for blades and 0.080 inch (2.03 mm) for frames].
 - 4. Louver Performance Ratings based on AMCA Performance:
 - a. Free Area: Not less than 47% free area
 - b. Air Performance: Intake Pressure Drop at 900 fpm free area face velocity -not more than 0.324-inch wg . Exhaust Pressure drop at 900 fpm free area velocity – not more than .30 – inch wg.
 - c. Wind-Driven Rain Performance: Not less than 95 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph per hour at a core-area intake velocity of 300 fpm.

2.4 BLANK-OFF PANELS

- A. Insulated, Blank-Off Panels outside intake ductwork: Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver.
 - 1. Thickness: 2 inches.
 - 2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
 - 3. Insulating Core: Extruded-polystyrene foam.
 - 4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
 - 5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
 - 6. Panel Finish: Same finish applied to louvers.
 - 7. Attach blank-off panels with clips.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.6 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with [AAMA 2604] [AAMA 2605] and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Custom Color and Gloss to match adjacent Siding

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrates and openings to receive louvers are rigidly set, at proper lines and elevation, properly sized, and ready to receive louvers.
- B. Do not proceed with installation until conditions detrimental to proper installation have been corrected.

3.2 PREPARATION

- A. Coat contact surfaces of dissimilar metals with one or more coats of bituminous paint.
 - 1. The following metals are not considered dissimilar: Aluminum, stainless steel, and zinc.
- B. Apply one 15-mil dry film thickness coat of bituminous isolation coating to metal surfaces, other than galvanized steel, which will be in contact with cementitious materials.

3.3 INSTALLATION

- A. Installation of door louvers is specified elsewhere.
- B. Install louvers in accordance with manufacturer's instructions and shop drawings.
- C. Coordinate louver installation with adjacent elements of building envelope to ensure watertight construction.
- D. Set units and flashings in proper location, plumb and true, free of warp or twist.
- E. Fit joints tightly; where joint sealers are to be installed, make joints of sizes required.
- F. Coordinate installation of actuated louvers with work of Division 23.

3.4 CLEANING

- A. Wash exposed surfaces using mild detergent; thoroughly clean inside corners.

- B. Remove excess sealant by moderate use of mineral spirits or other solvent recommended by sealant manufacturer.
 - 1. Touch up marred or abraded areas of finished elements. If satisfactory touch-up cannot be accomplished, remove and replace element.

END OF SECTION 238650

SECTION 260000 - GENERAL ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Scope of Work.
 - 2. Intent of Drawings.
 - 3. Pre-Bid Site Visit.
 - 4. Definitions.
 - 5. General Standards of Materials.
 - 6. Products and Substitutions.
 - 7. Applicable Codes.
 - 8. Guarantees and Certificates.
 - 9. Quiet Operation and Vibration Control.
 - 10. Temporary Shutdown of Existing Systems.
 - 11. Coordination.
 - 12. Shop Drawings, Product Data, and Samples.
 - 13. Owner Instruction.

1.3 SCOPE OF WORK

- A. The scope of the work included under Division 26 of the specifications shall include complete systems as shown in the Contract Documents and specified herein. Any work reasonably inferable or required to result in a complete installation or the intended operation and performance of the systems, shall be included in the Base Bid except where there is specific reference to exclusion and incorporation in other quotations.
- B. A brief written Scope of Work appears in Division 01.
- C. Items of labor, material, and equipment not specified in detail or shown on drawings, but incidental to or necessary for the complete installation and proper operation of the several branches of work and described herein, or reasonably implied in connection herewith, shall be furnished as if called for in detail by the specifications or drawings. This includes electrical work associated with mechanical and plumbing work whether indicated on electrical drawings or not.

1.4 WORK NOT INCLUDED

- A. The following items of Electrical Construction are not included in this contract:
 - 1. Certain low voltage wiring of mechanical equipment shall be done by the respective Contractor.
 - 2. Certain motors and equipment, such as pumps, fans, etc., shall be provided by others, complete with motor and built-in or separate controllers as covered by such contracts. The extent of work required by this Contractor in connection with the provisions of this equipment is described hereinafter under "Electrical Powered Equipment."

3. Motors connected to driven equipment shall be set by respective Contractor furnishing same.
4. Certain line voltage electrical apparatus such as switches, starters, controllers, transformers, etc., furnished by others shall be delivered to the curb by the Contractor furnishing the equipment, unless specifically noted otherwise. Unload and transport to installation location.
5. Electric heating equipment.

1.5 INTENT OF DRAWINGS

- A. Provide complete and functional systems for the project. The systems shall conform to the details stated in the specifications and shown on the drawings. Items or work not shown or specified, but required for complete systems, shall be provided and conform to accepted trade practices. The drawings and specifications are presented to define specific system requirements and serve to expand on the primary contract requirements of providing complete systems. The drawings are diagrammatic and indicate the general arrangement and routing of the systems included in this contractors work.
- B. Do not scale the drawings. Because of the scale of the drawings, it is not possible to indicate offsets, fittings, valves, or similar items which may be required to provide complete operating systems. Carefully investigate conditions affecting the work associated with this project. Check and verify dimensions and existing conditions at the site. Install systems in such a manner that interferences between pipes, conduit, ducts, equipment, architectural and structural features are avoided. Provide items required to meet the project conditions without additional cost to the owner.
 1. These documents may not explicitly disclose final details required for a complete systems installation; however, contractors shall possess the expertise to include the necessary appointments of complete operating systems.
 2. Bidders shall have sufficient expertise in this type of construction to realize the extent of the work required.

1.6 GENERAL STANDARDS OF MATERIALS

- A. Equipment and materials, unless otherwise noted, shall be new and of first quality, produced by manufacturers who have been regularly engaged in the manufacture of these products for a period of not less than five years.
- B. Equipment of one type shall be the products of one manufacturer; similar items of the same classification shall be identical, including equipment, assemblies, parts and components.
- C. Materials furnished shall be determined safe by a nationally recognized testing organization, such as Underwriters' Laboratories, Inc., or Factory Mutual Engineering Corporation, and materials shall be labeled, certified or listed by such organizations. Where third party certification is required for packaged equipment, the equipment shall bear the appropriate certification label.
- D. With respect to custom made equipment or related installations which are constructed specially for this project, the manufacturer shall certify the safety of same on the basis of test data. The Owner shall be furnished copies of such certificates.

1.7 APPLICABLE CODES

- A. Materials furnished and work installed shall comply with applicable codes listed in Division 01, with the requirements of the local utility companies, and with the requirements of governmental departments or authorities having jurisdiction.

1.8 GUARANTEES AND CERTIFICATES

- A. Defective equipment, materials or workmanship, including damage to the work provided under other divisions of this contract resulting from same, shall be replaced or repaired at no extra cost to the Owner for the duration of the stipulated guarantee periods.
 - 1. Unless specifically indicated otherwise, the duration of the guarantee period shall be one (1) year following the date of Substantial Completion. Temporary operation of the equipment for temporary conditioning, testing, etc., prior to occupancy will not be considered part of the warranty period.

1.9 QUIET OPERATION AND VIBRATION CONTROL

- A. Equipment and associated items shall operate under conditions of load without sound or vibration deemed objectionable by the Architect. In the case of moving equipment, sound or vibration noticeable outside of the room in which it is installed, or noticeable within the room in which it is installed, shall be deemed objectionable. Sound or vibration deemed objectionable shall be corrected in an approved manner at no extra cost to the Owner. Vibration control shall be provided by means of approved vibration isolators and installed in accordance with the isolator manufacturer's recommendations.
- B. The sound pressure levels around mechanical and electrical equipment (fans, pumps, motors, etc.) in equipment spaces shall not exceed 85 dBA at any point three (3) feet from the equipment, with all equipment in the room operating. The sound criteria apply to the complete range of each piece of equipment.

1.10 TEMPORARY SHUTDOWN OF EXISTING SYSTEMS

- A. Plan installation of new work and connections to existing work to insure minimum interference with regular operation of existing systems. Some temporary shutdown of existing systems may be required to complete the work.
- B. Submit to the Owner in writing for approval, proposed date schedule, time, and duration of necessary temporary shutdowns of existing systems. Submit schedule at least fifteen (15) calendar days in advance of intended shutdown. Shutdowns shall be made at such times as shall not interfere with regular operation of existing facilities and only after written approval of Owner. The Owner reserves the right to cancel shutdowns at any time prior to the shutdowns. To insure continuous operation, make necessary temporary connections between new and existing work. Bear costs resulting from temporary shutdowns and temporary connections. No additional charges shall be allowed for Owner-canceled shutdowns that must be rescheduled.
- C. Shutdowns must be performed by the Owner. Do not shut-down any system. The Owner reserves the right to require a walk-through of any shutdown prior to the shutdown. Following electrical shutdowns, verify that affected motors are rotating in the proper direction. Bear costs associated with reverse rotated motors.

1.11 COORDINATION

- A. Coordinate and furnish in writing to the Architect information necessary to permit the work to be installed satisfactorily and with the least possible interference or delay.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 260000

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.
6. Excavating and backfilling.
7. Demolition
8. Waterproofing.
9. Cutting and Patching.
10. Protection of Floors.
11. Painting.
12. Equipment Foundations, Supports, Piers and Attachments.
13. Equipment Guards and Rails.
14. Cleaning, Protecting and Adjusting.
15. Welding.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.
- C. Wiring: Cable and/or wire installed in Raceway.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 EXCAVATING AND BACKFILLING

- A. Excavate and backfill as required for the installation of this work.
- B. Trenches for underground wiring shall be excavated to required depths. Where rock is encountered, excavate to a grade 6 inches below the lowest part of the pipe and refill the

excavation below pipe grade with sand and gravel. Trenches shall have uniform grade as specified hereafter or shown on the Drawings.

- C. Trenches shall not be wider than 4 inches on each side of the raceway but not less than 12 inches wide.
 - D. Excavations shall be done on an unclassified basis. No extras shall be allowed regardless of type or hardness of material encountered.
 - E. No backfilling shall be done on any system requiring testing or inspection until such testing or inspection has been completed satisfactorily.
 - F. Shore and brace as required to maintain banks of excavation and avoid cave-ins and make good any damages to adjoining property or work in place caused by failure to properly shore excavations. Shoring shall conform to OSHA and Department of Labor and Industry requirements.
 - G. Backfilling shall be made in 6 inch layers, mechanically tamped. Wood, old forms, shoring, etc., shall be removed before backfilling. Backfill shall not contain any frozen material, ashes, slag, combustible material, rocks over 6 inches in the largest dimension, or any other material which the Architect considers unsuitable for the purpose. Particular care shall be exercised in backfilling areas where construction shall be placed above the backfill.
 - H. Satisfactory soil materials for backfill where contaminated soil is removed whether surplus from the existing site or trucked-in new shall meet the following requirements:
 - 1. ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM free from rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - I. Compaction of soil and backfill shall be as follows:
 - 2. Soil and backfill shall be compacted in 12 inch layers with each layer of soil or backfill compacted at 95 percent maximum dry density according to ASTM D 1557.
 - J. Shoring shall be removed after equipment and wiring have been installed and tested.
 - K. Keep available at all times pumping equipment which shall be used to pump any water from trenches and excavation under this Contract.
 - L. Remove from the site surplus excavated materials resulting from work. Surplus excavated materials include materials not suitable for use as backfill.
 - M. Comply with OSHA rules and regulations for protection of open trenches.
 - N. Notify utility companies for verification of underground utilities before any excavation takes place.
- 1.6 DEMOLITION
- A. Review the demolition drawings, to determine the affected areas of the existing structure. Remove electrical appurtenances in the affected areas not to be reused including wire, conduit, switches, outlets, light fixtures, and fittings. If any existing electrical items are to be removed, either patch area as required or provide a blank cover plate over boxes to remain.

- B. Any conduit or wiring that is not to be permanently removed or that feeds other remaining sections of the building shall be relocated as necessary and rerouted and reconnected as required.
- C. Items removed above shall become the property of the Owner unless otherwise noted. If the Owner has no use for any of the items, remove them from the site.
- D. Maintain the continuity of any present circuits that may be interrupted by these alterations even though they may not be indicated on the drawings. Furnish the labor and necessary materials required to restore the circuit.
- E. Where circuits are looped and outlets are removed, make adjustments and connections to restore the circuits.
- F. Participate in a recycling and disposal program for fluorescent lamps containing mercury and PCB ballasts. Pay all fees associated with recycling.
 - 1. Lamps
 - a. Recycle fluorescent lamps intact, place into lamp boxes, and mark box "for recycling."
 - b. Materials shall be transported to a state and federally approved recycling facility. Provide documentation that materials were recycled in accordance with State and Federal laws.
 - 2. Ballasts
 - a. Where PCB ballasts are identified, remove ballasts from fixture and place in a DOT1AZ shippable, removable head, 55 gallon steel drum. Date and label drum as "PCB Contaminated." Weight of drum shall not exceed 600 pounds.
 - b. Arrange for drums to be delivered to a state and federally approved recycling facility. Provide documentation that the materials were recycled in accordance with State and Federal laws.
- G. Where existing electrical devices and items are to be removed, ceilings, floors, wall partitions, etc., are to be patched by the Electrical Contractor. Particular attention must be paid to associated construction types and methods of affected areas. All patching for these areas is to match the existing and intended finishes for that area no matter what the type of construction. Coordinate all patching work fully with the Architect and General Contractor. Blank cover plates over demolished items will not be acceptable.

1.7 WATERPROOFING

- A. Where work pierces waterproofing, including waterproof concrete, the method of installation shall be approved by the Architect prior to performing the work. Furnish necessary sleeves, caulking and flashing required to make openings absolutely watertight.

1.8 WEATHERPROOFING LOCATIONS (WP)

- A. Electrical apparatus, such as outlet boxes, switches, thermal switches or manual starters, disconnect switches, combination switches and starters, motor control centers, and motor starters shall be weatherproof gasketed type, NEMA Types 3 or 4 in the following instances:
 - 1. On surface of exterior face of building, including areas where not under canopies, cast boxes with threaded hubs must be used and under canopies steel boxes with gasket connections to devices.
 - 2. In any areas where specifically noted "WP" or required by the NEC or Electrical Regulations mentioned herein.
 - 3. Within air conditioning enclosures.
 - 4. In underground splice boxes.
 - 5. On building roof.

1.9 CUTTING AND PATCHING

- A. Provide cutting and patching necessary to install the work specified herein. Patching shall match adjacent surfaces. Refer to Division 01, Cutting and Patching for specific directions.
- B. No structural members shall be cut without prior approval of the Architect; such cutting shall be done in a manner directed by him.
- C. Provide ceiling removal and replacement where work above ceilings is required. Replace ceiling components damaged in the process.
- D. Provide patching where electrical devices are removed from walls, ceilings or floors.

1.10 ACCESSIBILITY

- A. Coordinate to ensure the sufficiency of the size of shafts, and chases, and the adequacy of clearances in hung ceilings and other areas required for the proper installation of this work.
- B. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Locations in ceilings requiring access shall be coordinated with, but not limited to lights, curtain tracks, speakers, and medical gas tracks. Equipment requiring access shall include, but is not necessarily limited to, motors, junction boxes, fire dampers, controllers, switchgear, etc.
- C. Indicate the locations of access doors for each concealed device, concealed behind finished construction and requiring service on the coordination drawings. Equipment below floor slab or finished grade shall be also be indicated on the coordinating drawings.
- D. Furnish access doors under this division for installation by General Contractor. Coordinate during bidding phase with General Contractor. Locations of access doors in finished construction shall be submitted in sufficient time to be installed in the normal course of the work.
 - 1. Manufacturers: Subject to compliance with requirements, furnish access doors by one of the following:
 - a. Bar-Co., Inc.
 - b. J. L. Industries
 - c. Karp Associates, Inc.
 - d. Nystrom, Inc.

2. Materials and Fabrication:

- a. General: Furnish each access door assembly manufactured as an integral unit, complete with all parts and ready for installation.
- b. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction, unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
- c. Frames: Fabricate from 16-gauge steel.
 - 1) Fabricate frame with exposed flange nominal 1 inch wide around perimeter of frame for units installed in the following construction:
 - a) Exposed Masonry
 - 2) For gypsum drywall or veneer gypsum plaster, furnish perforated frames with drywall bead.
 - 3) For installation in masonry construction, furnish frames with adjustable metal masonry anchors.
 - 4) For full-bed plaster applications, furnish frames with galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- d. Flush Panel Doors: Fabricate from not less than 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175°. Finish with manufacturer's factory-applied prime paint.
 - 1) For fire-rated units, provide manufacturer's standard insulated flush panel/doors, with continuous piano hinge and self-closing mechanism.
- e. Locking Devices: Furnish flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.

1.11 PROTECTION OF FLOORS

- A. Protect existing flooring from damage during the construction period. Provide plywood or similar material under equipment or materials stored on floors, and in areas where construction may damage the floor surfaces. Floor surfaces (including sealer) damaged during the construction shall be replaced at the cost of the Contractor at fault.

1.12 PROTECTION OF SERVICES

- A. Repair, replace and maintain in service any new or existing utilities, facilities or services (underground, overground, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction. The method used in repairing, replacing or maintaining the services shall be approved by the Owner and Architect.

1.13 PAINTING

- A. Painting requirements of this section shall conform to Division 09 painting sections.

- B. Provide surface preparation, priming, and final coat application in strict accordance with manufacturer's recommendations.
- C. Electrical motors, pump casings and other similar items shall be provided with three (3) coats of machinery enamel at the factory, and shall be carefully cleaned, rubbed down and oiled after installation.
- D. Provide prime coat painting for the following:
 - 1. Indoor miscellaneous steel and iron provided under this Division of the specifications.
 - 2. Indoor hangers and supports provided under this Division of the specifications.

1.14 EQUIPMENT FOUNDATIONS, SUPPORTS, PIERS AND ATTACHMENTS

- A. Provide necessary foundations, auxiliary steel, supports, pads, bases and piers required for equipment specified in this division; submit drawings in accordance with Shop Drawing Submittal requirements prior to the purchase, fabrication or construction of same.
- B. Provide 4 inch thick concrete pads for base mounted transformers, switchboards, switchgear, rotating equipment, and floor-mounted equipment located in equipment rooms and as indicated on drawings. Pads shall be extended 6 inches beyond machine base in each direction with top edge chamfered.
- C. Construction of foundations, supports, and pads where mounted on the floor, shall be of the same materials and same quality of finish as the adjacent and surrounding floor material.
- D. Equipment shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Architect, not strong enough shall be replaced as directed, with no additional cost to the Owner.

1.15 CLEANING, PROTECTING AND ADJUSTING

- A. General cleaning requirements are specified in Division 01.
- B. Materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.
- C. Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and replacement if, in the opinion of the Architect or the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use or performance is questionable, or that its normal life expectancy has been curtailed.
- D. During the construction period, protect equipment from damage and dirt.
- E. Vacuum cabinets, switchboards, switchgear, lighting and power panels, etc., after completion of work.

F. Adjusting

1. After the entire installation has been completed, make required adjustments to balance panelboards and adjust lighting fixtures until performance requirements are met.

1.16 SPECIAL TOOLS

- A. Provide the Owner's representative with two (2) sets of special tools required for operation and maintenance of equipment provided.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Coordinate piping systems installed at a required slope.
- F. Apply for detailed and specific information regarding the location of equipment as the final location may differ from that indicated on the drawings. Outlets, equipment or wiring improperly placed because of failure to obtain this information shall be relocated and re-installed without additional expense to the Owner. Determine the actual direction of door swings, so that local switches and other controls shall be installed at the lockside of doors, unless otherwise noted. Improperly located switches shall be relocated without additional expense to the Owner.
- G. The design shall be subject to such revisions as may be necessary to overcome building obstructions. No changes shall be made in location of outlets or equipment without written consent of the Architect and Owner.
- H. Unless otherwise mentioned or indicated, mounting heights of outlets are shown on the drawings or in the specification. Dimensions given shall be considered to be from center of outlet to finished floor.
- I. Coordinate the location and elevation of all electrical devices and fixtures with the architectural interior elevation plan and reflective ceiling plan prior to installation.
- J. Properly rough in for the electrical conduit and equipment under this contract and modify as required for coordination during the construction period.

3.2 PENETRATION FIRESTOPPING

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Through-Penetration Firestop System."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Through-Penetration Firestop System."

3.5 DUST, DIRT AND NOISE

- A. Carry out new work and make changes, relocations, and installations with a minimum of noise. Site areas and new equipment, floors and walls, shall be adequately protected from dust and dirt caused by the work. Protection shall include suitable temporary barriers or coverings. The exterior and interior premises of each building shall be kept clean as possible during construction. Damages to surfaces or equipment as a result of negligence shall be replaced or corrected as required.
- B. School activities will be under way during much of the construction period. It is imperative that school functions and activities are given priority and the highest level of respect. Contractor functions which may be excessively noisy or disruptive shall be scheduled for times when school functions will not be interrupted or disturbed.

3.2 ENVIRONMENTAL AIR PLENUMS

- A. In spaces over hung ceiling which are used for environmental air handling purposes as defined by Article 300.22C of the National Electric Code, power data and communications cable must be in conduit or of the type cable rated for air plenum use. Cable type and/or raceway is generally indicated on the electrical drawings and specifications although the Contractor shall be responsible to clearly define ceiling space used for environmental air purposes.

END OF SECTION 260500

SECTION 260500.01.01 – COMMON WORK RESULTS FOR ELECTRICAL, SECURITY SUPPLEMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide a conduit and supportive electrical powering systems to support Electronic Security Systems as listed in paragraph 1.1. Coordinated with Section 280500 work. See submittal requirements for submittal requirements.
- B. Refer to 280500 Part 1

1.2 RELATED DOCUMENTS

- A. Refer to 280500 Part 1

1.3 RELATED DIVISION PROVISIONS

- A. Refer to 280500 Part 1

1.4 REFERENCES

- A. Refer to 280500 Part 1

1.5 SUMMARY

- A. Section includes requirement of Division 26 contractor to support electronic security systems work. This section provides requirements for planning, supplementary submittal requirements, product specifications and installation of conduit and electrical power systems supporting electronic security.

1.6 DEFINITIONS

- A. Refer to 280500 Part 1

1.7 SUBMITTALS

- A. General: Submittals shall adhere to submittal requirements outlined in Division 280500, Section 1.6. All submittals for Section 280500 including this supplement shall be submitted as one submittal as outlined in Section 280500, Paragraph 1.6.

- B. Group 1 Technical Data Package: The data package shall include the following:
1. Shop Drawings: Provide conduit systems plan for routing and sizing of all security conduits and enclosure assemblies.
 2. Construction Mock-up: In areas with exposed EMT/Conduit Raceways, Contractor shall conceal raceway as much as practical and unobtrusively. Installation means and methods should be approved by the Owner.
 3. Power Circuits & Calculation: Contractor shall provide power circuit schedule for each security component requiring high voltage power. The schedule shall include the following information:
 - a. Panel Location
 - b. Panel Nomenclature
 - c. Circuit Number
 - d. Type of Circuit (emergency power, UPS, etc.)
 - e. Circuit power consumption
- C. Product Data: For each type of product indicated in Part 2 of this section.

1.8 COORDINATION

- A. Refer to 280500 Part 1

1.9 QUALITY ASSURANCE

- A. Refer to 280500 Part 1

1.10 MAINTENANCE & SERVICE

- A. Refer to 280500 Part 1

1.11 SYSTEM DESCRIPTION

- A. The system shall be coordinate with 280500.

1.12 PERFORMANCE REQUIREMENTS

- A. Refer to 280500 Part 1

1.13 DELIVERY HANDLING & STORAGE

A. Refer to 280500 Part 1

1.14 PROJECT CONDITIONS

A. Refer to 280500 Part 1

1.15 EQUIPMENT AND MATERIALS

A. Refer to 280500 Part 1

1.16 ELECTRICAL POWER

A. Refer to 280500 Part 1

1.17 ENVIRONMENTAL CONDITIONS

A. Refer to 280500 Part 1

1.18 LIGHTNING, POWER SURGES, & GROUNDING

A. Refer to 280500 Part 1

1.19 COMPONENT ENCLOSURES

A. Refer to 280500 Part 1

1.20 ELECTRONIC COMPONENTS

A. Refer to 280500 Part 1

1.21 SUBSTITUTE MATERIALS & EQUIPMENT

A. Refer to 280500 Part 1

1.22 LIKE ITEMS

A. Refer to 280500 Part 1

1.23 WARRANTY

- A. Refer to 280500 Part 1

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. All materials, equipment, and devices shall, as a minimum, meet the requirements of UL where UL standards are established for those items, and the requirements of NFPA 70. All items shall be new unless specified or indicated otherwise.

2.2 CONDUIT AND FITTINGS

- A. Security related cabling and wiring shall be routed in the Division 27 AV/IT Contractor provided cable tray. Where cable tray is not available the Contractor shall provide and route security related cabling and wiring in conduit to the nearest cable tray. Where conduit is required the rest of this specification shall apply.

- B. Types:

- 1. Rigid (Where Required):

- a. Rigid Steel Conduit (Zinc-Coated) shall meet ANSI C80.1.
 - b. Rigid Aluminum Conduit shall meet ANSI C80.5.
 - c. Rigid Nonmetallic PVC Type Conduit EPC-40 in accordance with NEMA TC2, or UL approved fiberglass reinforced epoxy (FRE).
 - d. Conduit coupling and connectors shall be of a compression type. Set screw couplings and connectors shall not be permitted.

- 2. EMT (Where Required):

- a. Electric Metallic Tubing (EMT) shall meet ANSI C80.3.
 - b. Conduit coupling and connectors shall be of a compression type. Set screw couplings and connectors shall not be permitted.

- 3. Flexible Metal Conduit (Where Required):

- a. Liquid-Tight Flexible Metal Conduit (Steel) shall meet UL 360.

2.3 SPECIAL FIRE PANEL CONNECTIONS

- A. All conduits between the security panel assembly and fire control panels are to be recessed in the wall. These conduits shall be marked with blue and red tape to indicate their association with fire and security systems.

2.4 SECURITY JUNCTION BOX:

- A. The Contractor shall provide 6" x 8" metal junction box with cover and tamper proof Torx Center post security screws. Boxes containing security electronic circuitry shall be tampered.

2.5 ENCLOSURES:

- A. The Contractor shall provide metallic enclosures as needed for equipment not housed in racks or supplied with a housing. The enclosures shall be as specified or shown.
1. Interior: Enclosures to house equipment in an interior environment shall meet the requirements of NEMA 250-Type 12.
 2. Exterior: Enclosures to house equipment in an outdoor environment shall meet the requirements of NEMA 250-Type 4. Enclosures exposed to direct sunlight shall be finished with white polyester powder coating and be equipped with a sun shield finished to match the enclosure. Sun shield shall be mounted to protect the top of the enclosure from direct sun and shall extend at least 25.4 mm (1 in) beyond the edges of the enclosure on all sides.
 3. Corrosion-Resistant: Enclosures to house equipment in a corrosive environment shall meet the requirements of NEMA 250-Type 4X.
 4. Hazardous Environment: All system electronics to be used in a hazardous environment shall be housed in a metallic enclosure which meets the requirements of paragraph "Hazardous Environment."
 5. Tamper Provisions: Enclosures, cabinets, housings (other than environmental camera housings), and boxes of every description having hinged doors or removable covers, which contain any part of the data transmission media, circuits, termination or power supplies, shall be provided with cover operated, corrosion-resistant tamper switches, arranged to initiate an alarm signal when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. Tamper switches shall be inaccessible until the switch is activated; have mounting hardware concealed so the location of the switch cannot be observed from the exterior of the enclosure; be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode; and be wired so they break the circuit when the door or cover is disturbed. Tamper switches on the doors which must be opened to make routine maintenance adjustments to the system and to service the power supplies shall be push/pull-set, automatic reset type.
 6. Enclosure Covers: Covers of pull and junction boxes provided to facilitate installation of the system need not be provided with tamper switches if they contain no splices or connections and held in place with tamper proof Torx Center post security screws. Provide stenciled labels for each box.
 7. Construction of Enclosures:
 - a. Consoles, power supply enclosures, detector control and terminal cabinets, control units, wiring gutters, and other component housings, collectively referred to as enclosures, shall be so formed and assembled as to be sturdy and rigid.

- b. Thickness of metal in-cast and sheet metal enclosures of all types shall not be less than those in Tables I and II, UL 611. Sheet steel used in fabrication of enclosures shall be not less than 14 gauge. Consoles shall be 16-gauge. Doors and covers shall be flanged. Enclosures shall not have pre-punched knockouts. Where doors are mounted on hinges with exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent removal. Doors having a latch edge length of less than 609.6 mm (24 in) shall be provided with a single construction core. Where the latch edge of a hinged door is more than 609.6 mm (24 in) or more in length, the door shall be provided with a three-point latching device with construction core; or alternatively with two, one located near each end.
- c. Any ventilator openings in enclosures and cabinets shall conform to the requirements of UL 611. Unless otherwise indicated, sheet metal enclosures shall be designed for wall mounting with top holes slotted. Mounting holes shall be in positions that remain accessible when all major operating components are in place and the door is open, but shall be inaccessible when the door is closed.
- d. Covers of pull and junction boxes provided to facilitate initial installation of the system shall be held in place by tamper proof Torx Center post security screws. Stenciled or painted labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate the box is part of the Electronic Security System (ESS).

B. Wire Troughs

1. Wire troughs shall be utilized for all enclosure assemblies wire management practices.
2. Security Screws: Secure trough covers with tamper proof Torx Center post security screws.
3. Trough Mounting: Wire Troughs shall be mounted securely to fire resistant plywood meeting UL Standard for fire retardant backboards.

PART 3 - EXECUTION

3.1 GENERAL

A. Power (Division 26):

1. Primary Dedicated Electrical Power (20 Amp, 120 VAC) circuits shall be provided by this Contractor at locations shown on drawings. Primary Dedicated Electrical Power (20 Amp, 120 VAC) circuits shall be derived from sources supported emergency power. The Contractor shall provide all the connections between powered junction boxes and security equipment.
2. Division 26 Contractor shall provide cable trays required by the security systems. Security conduits shall be labeled with blue marking band or blue paint every 30 ft Security junction box covers shall be painted with paint manufactured by Benjamin Moore #791, or Duron 5085A (Americana).

B. HVAC (Division 25)

1. Division 25 Contractor shall provide a Liebert Cooling System or equivalent, for the Security Monitoring Control and Equipment rooms.

C. Conduit: The following security provisions apply to system conduit requirements:

1. Conduit shall be provided in accordance with The National Electrical Code (NEC), and the requirements of other Division 26 Sections.
2. All wiring shall be installed in conduit and in cable trays or raceways when specifically permitted in Contract Documents. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per the NEC.
4. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the security control panel, or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the manufacturer.
6. Conduit shall be 3/4" minimum, except 1/2" flexible conduit is permitted when connecting to a single device.

D. Terminal Boxes, Junction Boxes and Cabinets:

1. All boxes and cabinets shall be UL listed for their use and purpose. Screws extending outside any cabinets shall be cut off and filed smooth to prevent any injury.
2. The security 120 VAC power supplies shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as Security. Security 120 VAC primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to a suitable ground.
3. Enclosure Penetrations: All enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.
4. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
5. Wire Troughs: Wire troughs shall be utilized for all enclosure assemblies wire management practices. Security Screws: Secure trough covers with tamper proof Torx Center post security screws. Trough Mounting: Wire Troughs shall be mounted securely to fire resistant plywood meeting UL Standard for fire retardant backboards.
6. Backboards: Plywood, fire-retardant treated, 19 x 1220 x 2440 mm (0.75 x 48 x 96 in) minimum with actual dimensions to match panel assembly sizing. Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

PART 4 - SYSTEM PROGRAMMING

4.1 NOT APPLICABLE

PART 5 - TESTING AND ACCEPTANCE

5.1 FIELD TESTS:

- A. Contractor shall perform field test of all electrical circuits to ensure they conform to project requirements. A ground test shall be performed on all grounding systems to ensure continuity in the entire grounding system.
- B. Unit Control Room
 - 1. Contractor shall confirm the source, operation, and labeling of all power circuits.

5.2 REFER TO 280500 PART 5

END OF SECTION 260500.01 - SUPPLEMENT

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
- B. Related Sections include the following:
 - 1. Division 26 Section "Common Work Results for Electrical".

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Insulated Wire Corp.; a Leviton Company.
 - 2. General Cable Corporation.
 - 3. Cablec Continental Cable Company.
 - 4. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN, XHHW, USE and SO.
- D. Multiconductor Cable (where permitted): Comply with NEMA WC 70 for metal-clad cable, Type MC, nonmetallic-sheathed cable, Type NM Type SO and Type USE with ground wire.
- E. Wiring on load side of isolation panel shall have insulation with a dielectric constant less than 3.5 and insulation resistance greater than 6,100 megohm/meter at 16 degrees C. Do not use wire pulling lubricants or soaps when pulling these conductors.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Thomas & Betts Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper: Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Wire smaller than No. 12 AWG shall not be used for lighting or power circuits.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- F. Feeders in Cable Tray: Type THHN-THWN, single conductors in raceway.
- G. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- H. Branch Circuits Concealed in Accessible Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway, Metal-clad cable, Type MC.
- I. Branch Circuits Concealed in Concrete Masonry, Above Inaccessible Ceilings, Below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- K. Branch Circuits in Cable Tray: Type THHN-THWN, single conductors in raceway.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- M. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- N. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Metal Clad Cabling shall be secured every six feet and within 12 inches of every box or termination as required by code. Installation of metal clad cabling shall be done in a neat and workmanlike manner and follow or be perpendicular to building lines.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Splices and taps are not allowed to be installed in this project.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.
- D. Copper conductors #10 AWG and smaller shall be terminated and spliced with wire nut connectors. The nylon self-insulated type shall be used to isolate the termination from other metal parts and equipment.
- E. Copper conductors #8 AWG and larger shall be terminated, spliced, and tapped with color-keyed compression connectors. The manufacturers recommended tools and dies shall be used.
- F. Copper cable lug connections #8 and larger to copper bus bar mains and branches shall use copper solderless connectors having either 2-bolt cast copper clamps or compression connectors, with manufacturer's recommended hexagonal dies and hydraulic compression tools.
- G. Where terminal strips are indicated, provide strips having each terminal equipped with two clamp type pressure lugs or two washer bead binding screws. Use terminal strips having 20 ampere minimum terminal ratings. Provide a white marking strip along the center line of each row of terminals for identification. Use strips having plastic barriers between adjacent terminals. Provide terminal quantities indicated. If quantity is not indicated, provide one terminal for each conductor entering enclosure plus 20 percent spare terminals. Type or otherwise mark the identification strip to identify each connected circuit. Relate identification to wiring diagrams, panel schedules and other terminals in a logical manner, where specific identification

requirements are not indicated. Under no circumstances shall more than one wire be terminated under each terminal. Use only approved type jumper to mechanically connect terminals to each other.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test, service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
 - a. 300 volt feeders
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- D. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Common ground bonding with lightning protection system.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
 - 5. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings grounding, connections for separately derived systems based on NETA MTS NFPA 70B.
 - a. Tests shall determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 by 36 inches (6 by 50 by 900mm) in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury with in duct bank trench when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 3 inch (75 mm), minimum, from wall 8 inches (200 mm) above finished floor, unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Exothermic welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Exothermic welded connectors.
 - 4. Connections to Structural Steel: Exothermic welded connectors.

3.2 GROUNDING OVERHEAD LINES

- A. Comply with IEEE C2 grounding requirements.
- B. Install 2 parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.
- C. Drive ground rods until tops are 12 inches (300 mm) below finished grade in undisturbed earth.
- D. Ground-Rod Connections: Install exothermic welded connectors for underground connections and connections to rods.
- E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.

- F. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.
- G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 24 inches (600 mm) from the foundation.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-36-inch (6-by-50-by-900-mm) grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- G. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 6 inches (150 mm) below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance unless otherwise indicated. Set top of test well flush with finished grade or floor.

- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
 - 1. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inches (600 mm) from building foundation.

- J. Under Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 2 AWG.
 - 1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

- B. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.

- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch (14-mm) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.

- 3) Hilti Inc.
- 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
- 5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, RMC, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: [Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts] [Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69] [Spring-tension clamps].
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
 - 9. Items mounted to walls with steel studs space 16" on center: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices shall be secured to steel stud framing, blocking and/or structural elements within the wall.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Cold Formed Metal Framing" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified.

- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground ducts and raceways for electrical systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. RSC: Rigid galvanized steel conduit.
- G. GRC: Galvanized rigid conduit.
- H. LFMC: Liquidtight flexible metal conduit.
- I. LFNC: Liquidtight flexible nonmetallic conduit.
- J. NBR: Acrylonitrile-butadiene rubber.
- K. RNC: Rigid nonmetallic conduit.
- L. SMR: Surface metal raceway.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
 - 2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- D. Qualification Data: For professional engineer and testing agency.
- E. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflec Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. Manhattan/CDT/Cole-Flex.
 - 7. Maverick Tube Corporation.
 - 8. O-Z Gedney; a unit of General Signal.
 - 9. Wheatland Tube Company.
- B. Rigid Galvanized Steel Conduit: ANSI C80.1.
- C. Rigid Conduit: ANSI C80.5.

- D. IMC: ANSI C80.6.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- F. EMT: ANSI C80.3.
 - 1. Color Coded EMT: Hot-galvanized EMT conduit with a factory applied top coat available in seven colors, ANSI C80.3.
- G. FMC: Zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket.
- I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- J. Joint Compound for Rigid Galvanized Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Electri-Flex Co.
 - 4. Lamson & Sessions; Carlon Electrical Products.
 - 5. Manhattan/CDT/Cole-Flex.
 - 6. RACO; a Hubbell Company.
 - 7. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- D. LFNC: UL 1660.
- E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arco Corporation.
 2. Endot Industries Inc.
 3. IPEX Inc.
 4. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible type, approved for plenum or riser or general-use installation.

2.4 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.
 2. Hoffman.
 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 or 12 or 3R, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type or Flanged-and-gasketed type.
- E. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect or Prime coating, ready for field painting.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Wiremold Company (The); Electrical Sales Division.
 - b. Thomas & Betts Corporation.
 - c. Hubbell Wiring Devices.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard or custom colors.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Hubbell Incorporated; Wiring Device-Kellems Division.
 - b. Lamson & Sessions; Carlon Electrical Products.

- c. Panduit Corp.
- d. Walker Systems, Inc.; Wiremold Company (The).
- e. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Hoffman.
 - 4. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 5. O-Z/Gedney; a unit of General Signal.
 - 6. RACO; a Hubbell Company.
 - 7. Robroy Industries, Inc.; Enclosure Division.
 - 8. Spring City Electrical Manufacturing Company.
 - 9. Thomas & Betts Corporation.
 - 10. Walker Systems, Inc.; Wiremold Company (The).
 - 11. Carlon Electrical Products.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Metal Floor Boxes: Cast or sheet metal, fully adjustable or semi-adjustable, rectangular.
- F. Nonmetallic Floor Boxes: Nonadjustable, round.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized with gasketed cover.
- I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- J. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
1. Color of Frame and Cover: Gray or Green.
 2. Configuration: Units shall be designed for flush burial and have open or closed or integral closed bottom, unless otherwise indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, "**ELECTRIC**".
 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 7. Handholes 24 inches wide by 24 inches long (600 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide Quazite or a comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: RSC.
 2. Concealed Conduit, Aboveground: RSC.

3. Underground Conduit: RNC, Type EPC-40.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, Stainless Steel.
6. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Fire Alarm backbone from FACP to Annunciator, terminal panels, expander panels, amplifiers: IMC or RSC.
2. Exposed, Not Subject to Physical Damage: EMT.
3. Exposed, Not Subject to Severe Physical Damage: EMT or IMC.
4. Exposed and Subject to Severe Physical Damage: RSC. Includes raceways in the following locations:
 - a. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - b. Mechanical rooms.
 - c. Transformer vaults.
5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
7. Damp or Wet Locations: RSC.
8. Surface Mounted Raceway
 - a. Combination Power and Communications surface non-metallic raceway – Where shown on drawings to serve receptacles and low-voltage devices.
 - b. Surface Metal Raceway – Where subject to physical damage to serve receptacles or devices on existing block or concrete walls that cannot be fished. Includes raceways in the following locations:
 - 1) Corridors
 - 2) Storage Rooms
 - 3) Mechanical Rooms/Equipment Rooms
 - c. Surface non-metallic raceway – Where not subject to physical damage to serve receptacles or devices on existing block or concrete walls that cannot be fished. Includes raceways in finished areas not indicated above.
 - d. In existing accessible wall locations – branch circuits shall be concealed to serve devices.
 - e. In new construction, all branch circuiting to be concealed in construction.
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

10. Color Coding:

<u>Color</u>	<u>Application</u>
Red	Emergency, Fire Alarm, Security
Orange	Fiber Optics
Yellow	High Voltage, Medium Voltage
Green	Emergency Healthcare Critical, Nurse Call
Blue	Low Voltage, Datacom Video
Silver	Normal Power, Lighting

In exposed areas, as indicated to blend in with architecture, conduits to be painted to match structure or as directed by Architect.

- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded galvanized rigid steel conduit fittings, unless otherwise indicated.
 - 2. EMT: Compression watertight or drive-on watertight.
 - 3. FMC: Set screw or thread-in type as approved by the enforcing Code.
 - 4. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Use fittings made of the same material as the raceway except:
 - 1. Malleable iron and steel are interchangeable.
 - 2. Die cast fittings may be used for flexible steel conduit, and for factory manufactured off-sets.
 - 3. Use plastic insulated bushings for conduit sizes larger than 1 inch.
 - 4. Use steel insulated throat connectors for electrical metallic tubing where entering panel boards, switchboards, etc.
- F. Use steel fittings that are galvanized, cadmium-plated, or have other approved similar protective coating.
- G. Use double locknuts for terminating rigid conduit at sheet metal enclosures and equip conduit ends with bushings.
- H. Provide expansion fittings on every raceway larger than 1-1/2 inches, and use a 2 foot piece of seal tight on all conduit 1-1/2 inches and smaller where it crosses any building expansion joints. Verify exact location of building expansion joints shown on architectural and/or electrical drawings prior to installation of raceway.
- I. Use PVC coated fittings for rigid PVC coated steel conduit.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which two 90-degree bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Conduit required for slab on grade installations shall be installed in gravel sub-base, below the vapor barrier.
- I. Raceways Embedded in Slabs:
 - 1. Conduits shall not be installed in floor slabs, above grade, except where necessary to serve a floor box. Conduits to floor box shall be installed parallel with the corrugations of floor deck. Maximum conduit size shall not exceed [3/4 inch] [1 inch] [1 1/4 inch].
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 24 inches (600 mm) of slack at each end of pull wire.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.

- N. Surface mounted raceways to be secured to surface as specified in Division 26 Section "Hangers and Supports for Electrical Systems" and not rely on adhesive tape backing for support.
 - O. Expansion-Joint Fittings (RNC): Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).
 - 1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) temperature change.
 - 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
 - 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
 - B. Expansion-Joint Fittings (Metallic conduit): Provide expansion fittings on every raceway larger than 1-1/2 inches, and use a 24 inch piece of LFMC on all conduit 1-1/2 inches and smaller where it crosses any building expansion joints. Verify exact location of building expansion joints shown on architectural and/or electrical drawings prior to installation of raceway.
 - P. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC in damp or wet locations not subject to severe physical damage.
 - Q. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
 - R. Set metal floor boxes level and flush with finished floor surface.
 - S. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- 3.3 INSTALLATION OF UNDERGROUND CONDUIT
- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe 6 inches (150 mm) in nominal diameter or less.
 - 2. Install backfill as specified in Division 31 Section "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit to the equipment or horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a 6 inch, level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 2 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below the frost line, 30 inches below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
 - 2. Handholes and boxes.

1.3 DEFINITION

- A. RNC: Rigid nonmetallic conduit.
- B. RSC: Rigid steel Conduit.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Duct-bank materials, including separators and miscellaneous components.
 - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Accessories for handholes, boxes, and other utility structures.
 - 4. Warning tape.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Reinforcement details.
 - 3. Frame and cover design and manhole frame support rings.
 - 4. Ladder details.
 - 5. Grounding details.
 - 6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - 7. Joint details.

- C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Cover design.
 - 3. Grounding details.
 - 4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
- D. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 - 2. Drawings shall be signed and sealed by a qualified professional engineer.
- E. Qualification Data: For professional engineer and testing agency.
- F. Source quality-control test reports.
- G. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Construction Manager and/or Owner in writing no fewer than 10 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's and/or Owner's written permission.

1.8 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Furnish cable-support stanchions, arms, insulators and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. RSC: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ARNCO Corp.
 - 2. Beck Manufacturing.
 - 3. Cantex, Inc.
 - 4. Condux International, Inc.
 - 5. ElecSys, Inc.
 - 6. Electri-Flex Company.
 - 7. IPEX Inc.
 - 8. Lamson & Sessions; Carlon Electrical Products.
 - 9. Manhattan/CDT; a division of Cable Design Technologies.
 - 10. Spiraduct/AFC Cable Systems, Inc.
- B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type DB-60-PVC, ASTM F 512, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

C. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.3 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.

1. Color: Gray
2. Configuration: Units shall be designed for flush burial and have open, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC".
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by a independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40 PVC, in direct-buried duct bank, unless otherwise indicated.
- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40 PVC, in direct-buried duct bank, unless otherwise indicated.
- D. Underground Ducts Crossing Paved Paths, Walks, Driveways and Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.2 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
 - 4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

3.3 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," and Section 260500 "Common Work Results for Electrical" but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turfs and Grasses" and "Plants."
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.4 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1220 mm) both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 5 feet (1.5 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section, "Common Work Results for Electrical."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- G. Pulling Cord: Install 100 lbf (445 N) test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
 - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Use power-driven agitating equipment for duct-bank application to ensure even distribution of concrete.
 4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth, foreign piping, roadways and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups. Extend reinforced encasement 6 feet minimum beyond disturbed earth, foreign piping, roadways and where indicated.
 5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 12 inches (300 mm) between power and signal ducts.
 7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
 8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
 9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
 10. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.
- I. Direct-Buried Duct Banks:
1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
 2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.

3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" and Division 26 Section "Common Work Results for Electrical for pipes less than 6 inches (150 mm) in nominal diameter.
4. Install backfill as specified in Division 31 Section "Earth Moving" and Division 26 Section "Common Work Results for Electrical.
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 12 inches (300 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
11. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.5 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a six inch level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below the frost line, 36 inches below grade.

- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving or concrete and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on six inches of crushed stone.
 - 1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.

3.6 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.8 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Fire Alarm Circuits: Red letters on natural field.
 - 3. Legend: Indicate system or service and voltage, if applicable.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

2.3 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).
- C. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).
- D. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Sheet metal or rivet fastener, with white letters on a black background. Minimum letter height shall be 3/8 inch (10 mm).

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength: 50 lb (22.6 kg), minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 01 painting Sections.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.8 ELECTRICAL ROOM SIGNAGE

- A. In each Electrical Room provide a sign which illustrates the building floor plans with the location of the electrical rooms on all levels of the building. This sign shall also indicate the location of the Main Electrical Room along with the location of the main disconnect.
 1. The sign shall be mounted on the wall of the each Electrical Room and shall be housed in a metal frame with glass cover.

2.9 PHOTOVOLTAIC SYSTEM IDENTIFICATION

- A. Main Service Disconnect Marking: Provide a permanent label to the main service disconnect panel serving the photovoltaic systems. Label shall be red with white capital letters (minimum 3/4" in height) with the description: "WARNING: PHOTOVOLTAIC POWER SOURCE."

- B. **Circuit Disconnecting Means Marking:** Provide a permanent label adjacent to the circuit breaker serving the inverter for the photovoltaic system electrical controller. Label shall be black with white letters (minimum 3/8" in height) with the description: "PHOTOVOLTAIC DISCONNECT."
- C. Provide markings on all conduit, raceway, enclosures, cable assemblies, and junction boxes associated with the photovoltaic system, including the inverter. Mark all dc conduits, raceways, enclosures, and cable assemblies every 10 ft., at turns, and above and below all penetrations. Markings for all dc related electrical devices shall be red with white capital letters (minimum 3/8" in height) with the description: "WARNING: PHOTOVOLTAIC POWER SOURCE."
- D. Provide signage, acceptable to the AHJ, adjacent to the main disconnect indicating the name and emergency telephone number of the installing contractor.

PART 3 - EXECUTION

3.1 APPLICATION

- A. **Raceways and Duct Banks More Than 600 V Concealed within Buildings:** 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.
 - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. **Accessible Raceways and Metal-Clad Cables More Than 600 V:** Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches (50 mm) high. Repeat legend at 10-foot (3-m) maximum intervals.
- C. **Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 90 A:** Identify with orange label.
- D. **Accessible Raceways and Cables of Auxiliary Systems:** Identify the following systems with color-coded, labels applied in bands:
 - 1. Fire Alarm System: MC with Red stripe.
 - 2. Fire-Suppression Supervisory and Control System: Red and yellow.
 - 3. Combined Fire Alarm and Security System: Red and blue.
 - 4. Security System: Blue and yellow.
 - 5. Mechanical and Electrical Supervisory System: Green and blue.
 - 6. Telecommunication System: Green and yellow.
 - 7. Control Wiring: Green and red.
- E. **Power-Circuit Conductor Identification:** For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use write-on tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

- F. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply laminated acrylic/melamine plastic with either sheet metal or rivet fastener warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- J. Instruction Signs:
 - 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
 - 2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch (10-mm) high letters for emergency instructions at equipment used for power transfer and/or load shedding.

- K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a five lines of text:
 - 1) First Line: 1/2-inch (13-mm) letters on the first line stating equipment name.
 - 2) Second line (if applicable): 3/8-inch (10-mm) letters stating the existing equipment name in Parentheses ().
 - 3) Third line: 3/8-inch (10-mm) letters stating voltage/phase.
 - 4) Fourth line: 3/8-inch (10-mm) letters stating the breaker number, panel name and room number/name (Owner's room number) from which the equipment is fed.
 - 5) Fifth line: 3/8-inch (10-mm) letters stating function and/or equipment which it controls.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 2. Receptacle Labeling: Label shall be using Dymo Posiprinter, black lettering on clear tape stating panel and breaker number from which it is fed.
 3. Equipment to Be Labeled: (NO adhesive - laminated acrylic/melamine plastic with either sheet metal or rivet fastener.)
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchgear and switchboards.
 - d. Transformers.
 - e. Electrical substations.
 - f. Emergency system boxes and enclosures.
 - g. Motor-control centers.
 - h. Disconnect switches.
 - i. Enclosed circuit breakers.
 - j. Motor starters.
 - k. Push-button stations.
 - l. Power transfer equipment.
 - m. Contactors.
 - n. Remote-controlled switches, dimmer modules, and control devices.
 - o. Battery inverter units.
 - p. Battery racks.
 - q. Power-generating units.
 - r. Master clock and program equipment.
 - s. Monitoring and control equipment.
 - t. Uninterruptible power supply equipment.
 - u. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
 - v. Receptacles

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- E. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - 2. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Grey
 - 3. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
- H. Painted Identification: Prepare surface and apply paint according to Division 01 painting Sections.

END OF SECTION 260553

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes computer-based, fault-current, overcurrent protective device coordination studies, and ARC flash hazard study. Protective devices shall be set based on results of the protective device coordination study. Data used in the study must be for the specific equipment and devices provided under the construction contract.

1.3 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form. (The following submittals shall be made prior to granting final approval of the distribution equipment shop drawings and prior to release of equipment for manufacture.)
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.
 - 4. ARC Flash Hazard Study
 - 5. CD ROM of report with program data input files.

1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: A licensed engineer experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide SKM Systems Analysis, Inc. or a comparable product by one of the following:
 - 1. CGI CYME.
 - 2. EDSA Micro Corporation.
 - 3. ESA Inc.
 - 4. Operation Technology, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 - 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Complete study prior to final release of equipment for manufacture.
- B. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and preliminarily approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance, coordinate with Utility.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, instantaneous and GFCI adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchgear, switchboards and motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchgear and switchboard bus.

2. Distribution panelboard.
 3. Automatic transfer switch.
 4. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 4. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
 2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
- F. Equipment Evaluation Report:
1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- 3.4 COORDINATION STUDY
- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.

- C. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- F. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC FLASH WARNING LABELS

- A. Provide a 3.5 inch by 5 inch thermal transfer type label of high adhesion polyester for each work location analyzed.

- B. The label shall have an orange header with the wording, "WARNING, ARC FLASH HAZARD," and shall include the following information:
 - 1. Location designation
 - 2. Nominal voltage
 - 3. Flash protection boundary
 - 4. Hazard risk category
 - 5. Incident energy
 - 6. Working distance
 - 7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field marking.
- D. ARC flashing labels shall be provided in the following manner, and all labels shall be based on recommended overcurrent device settings.
 - 1. For each 480 and applicable 208 volt panelboards and disconnects, one ARC flash label shall be provided.
 - 2. For each low voltage switchboard, one ARC flash label shall be provided.

3.6 ARC FLASH WARNING LABELS

- A. The equipment vendor shall train personnel of the potential ARC flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces, shall be provided in the equipment manuals.

END OF SECTION 260573

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The purpose of this section is to specify the Contractor's responsibilities and participation in the commissioning process.
 - 1. Developing and witnessing the Commissioning process is the responsibility of the Commissioning Authority.
 - 2. Performing the Commissioning is primarily the responsibility of the Contractor, with support for start-up, testing, and commissioning testing.
 - 3. The commissioning process does not relieve the Contractor from participation in the process, or diminish the role and obligations to complete all portions of work in a satisfactory and fully operational manner.
- B. Commissioning Work includes:
 - 1. Testing and start-up of the electrical equipment.
 - 2. Providing qualified personnel to assist in commissioning tests, including seasonal testing required after the initial commissioning.
 - 3. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
 - 4. Completion and endorsement of pre-functional test checklists to assure that equipment and systems are fully operational and ready for functional testing.
 - 5. Providing operation and maintenance information and as-built drawings to the Commissioning Authority for review and verification prior to distribution.
 - 6. Providing training for the systems specified with coordination by the Commissioning Authority

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. All testing and start-up procedures and documentation requirements are specified within Divisions 1, 23, 26 and related portions of this project.
- B. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.
- C. Division 23 Section "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.
- D. Division 23 Section "Commissioning of Integrated Automation" for commissioning process activities for integrated automation systems, assemblies, equipment, and components.
- E. Division 23 Section "TAB Commissioning" for commissioning process activities for Testing, Adjusting and Balancing.

1.3 SUBMITTALS

- A. In addition to the stated requirements for operation and maintenance data, provide one copy of equipment technical literature, operation and maintenance literature, and shop drawings to the Commissioning Authority as soon as they are available. This requirement is for review of these documents prior to distribution of multiple copies for the Owner's final use.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. This contractor shall provide standard and specialized test equipment as necessary to start-up and test the electrical systems.
- B. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Authority in the commissioning process.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCEDURES THAT REQUIRE PARTICIPATION.

- A. Allow sufficient time before final completion dates so electrical systems start-up, testing and commissioning can be accomplished. For specified electrical systems and component testing by a third-party testing contractor, coordinate with the Commissioning Authority, the scope and schedule of that testing for observation by the Commissioning Authority during the actual testing.

3.2 WORK PRIOR TO COMMISSIONING

- A. Complete all phases of the work so the system can be energized, started, tested, and otherwise commissioned. The Contractor has primary start-up responsibilities with obligations to complete systems, including all sub-systems so they are functional. This includes the complete installation of all equipment, materials, raceways, wire terminations, controls, per the Contract Documents and related directives, clarifications, change orders.
- B. A commissioning plan will be developed by the Commissioning Authority. The commissioning plan will be developed prior to completion of the installation. The Contractor shall review the commissioning plan and comply with the requirements.
- C. If system modifications or clarifications are incorporated to this and related sections of work, commissioning of this work will be made at no additional cost to the Owner. If Contractor-initiated system changes have been made that alter the commissioning process, the Commissioning Authority will notify the Architect, and the Contractor may be obligated to test the revised product, or confirm the suitability/unsuitability of the substitution or revision.
- D. Specific pre-commissioning responsibilities in accordance with 01 91 13 General Commissioning Requirements are as follows:
 - 1. Normal start-up services required to bring each system into a fully operational state. This includes motor rotational check, lug tightening, control sequences of operation. The Commissioning Authority will not begin the commissioning process until each system is complete, including normal contractor start-up and debugging.
 - 2. The Contractor shall perform pre-functional tests on the following equipment and systems. Contractor start-up forms may be substituted for the pre-functional test forms with prior approval by the Commissioning Authority.
 - a. Packaged Engine Generator.
 - b. Transfer Switches.
 - 3. Factory start-up services will be provided for key equipment and systems. The Contractor shall coordinate this work with the manufacturer and the CA.
 - 4. Commissioning is intended to begin upon completion of a system. Commissioning may proceed prior to the completion of systems and/or sub-systems, if expediting this work is in the best interests of the Owner. Commissioning activities and schedule will be coordinated

with the Contractor. Start of commissioning before system completion will not relieve the Contractor from completing those systems as per the schedule.

3.3 PARTICIPATION IN COMMISSIONING

- A. Provide skilled technicians to start-up and debug all systems. These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, and time required for testing will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and problem resolutions.
- B. System problems and discrepancies may require additional technician time, Commissioning Authority time, redesign and reconstruction of systems, and system components. The additional technician time shall be made available for the subsequent commissioning periods until the required system performance is obtained.
- C. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system and sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service and commission the equipment, and an attitude and willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.

3.4 WORK TO RESOLVE DEFICIENCIES

- A. In some systems, misadjustments, misapplied equipment, and deficient performance under varying loads will result in additional work being required to commission the systems. This work will be completed under the direction of the Architect, with input from the Contractor, equipment supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate and work out problems, the Architect of Record will have final jurisdiction on the necessary work to be done to achieve performance.
- B. Corrective work shall be completed in a timely fashion to permit the timely completion of the commissioning process. Experimentation to render system performance will be permitted. If the Commissioning Authority deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Authority will notify the Architect/Engineer indicating the nature of the problem, expected steps to be taken, and the deadline for completion of activities. If the deadline(s) passes without resolution of the problem, the Owner reserves the right to obtain supplementary services and equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner will be the Contractor's responsibility.

3.5 TRAINING

- A. The Contractor will be required to participate in the training of the Owner's engineering and maintenance staff for each electrical system and the related components. Training may be conducted in a classroom setting, with system and component documentation and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner's option.

- B. Training will be conducted jointly with the Commissioning Authority, the design engineers, the equipment vendors, and the Contractor. The Contractor will be responsible for the generic training, as well as instructing the Owner's staff on the system peculiarities specific to the project.

END OF SECTION 26 08 00

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Outdoor photoelectric switches.
 - 2. Daylighting sensors.
 - 3. Indoor occupancy sensors.
 - 4. Outdoor motion sensors.
 - 5. Lighting contactors.
 - 6. Emergency shunt relays.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.
- C. RGS: Rigid Galvanized Steel
- D. IMC: Intermediate Metal Conduit

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. Amperage and Voltage ratings of equipment.
 - 3. UL Label.
 - 4. Manufacturer and catalog number.
 - 5. Layout of devices on floor plans with required components.
- C. Field quality-control test reports.

- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Description: conduit mounting, die cast housing, SPST dry contacts rated 1800 VA to operate relay or contactor coils
 1. Light-Level Monitoring Range: 1.5 to 15 fc with manually adjustable slide level.
 2. Time Delay: 2 minutes to prevent false operation.
 3. Mounting: 3/4" RGS or IMC conduit.
 4. Manufacturers: subject to compliance with requirements, provide products by one of the following:
 - a. TORK – 2100 Series
 - b. Paragon Electric Company – CW Series
 - c. LC&D – 2400 PCO

2.2 DAYLIGHTING SENSORS

- A. Description: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye.
 1. Manufacturers: (No substitutions)
 - a. Lutron

2.3 INDOOR OCCUPANCY SENSORS

- A. Dual-Technology Type: Wall or ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
 1. The Dual Technology sensor shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
 2. Sensors shall use ultrasonic diffusion technology that spreads coverage to a wider area.

3. Sensor shall utilize dual sensing verification principle for coordination between ultrasonic and PIR technologies. In the Ultrasonic technology, detection verification of both technologies must occur in order to activate lighting systems.
4. Sensor shall have a retrigger feature in which detection by either shall hold lighting on.
5. Sensor shall be mounted to the ceiling with a flat, unobtrusive appearance and provide 360° of coverage.
6. Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall utilize advance signal processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
Ultrasonic pattern of coverage shall be 64 feet in length by 32 feet in width, with device centered in this area.
7. To avoid false ON activations and to provide immunity to RFI and EMI, detection signature analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals cause by human motion.
8. The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
PIR pattern of coverage shall be 45 feet in diameter for half-step walking motion.
9. Sensors shall be powered by low voltage power. Low voltage sensors shall operate at 24 VDC/VAC, utilizing a power pack to supply 24 VDC/VAC.
10. Low voltage sensors shall be utilized in all areas. In individual offices, classrooms and labs the second set of contacts shall be controlled via building automation system. Power packs shall be powered by local lighting circuit.
11. Ultrasonic Sensors shall utilize solid state technology to optimize time delay and sensitivity settings to fit occupant usage patterns, selectable with a DIP switch.
12. Sensors shall have a time delay that is adjusted automatically or shall have a fixed time delay of 5 to 30 minutes, set by DIP switch.
13. The sensors shall have a built-in light level sensor that works from 10 to 300 footcandles.
14. The low voltage sensors shall have a manual on function that is facilitated by installing a momentary switch.
15. Sensors shall have eight occupancy logic options giving the ability to customize control to meet application needs.
16. The sensors shall feature terminal style wiring.
17. Wall mounted sensors shall be available with dual switches to control two zones of lighting, using power packs.
18. The sensor shall have an additional single-pole, double throw isolated relay with normally open, normally closed and common outputs. The isolated relay is for use with HVAC control, data logging, and other control options.
19. Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less sensor visibility.
20. To ensure quality and reliability, sensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
21. Sensors shall have standard 5 year warranty and shall be UL and CUL listed.
22. Manufacturers: This specification is based on Hubbell dual technology occupancy sensors. Provide products listed below:
 - a. Hubbell building automation - OMNIDT (ceiling), LHMTD2 (wall)
 - b. Lutron Equivalent

2.4 EMERGENCY SHUNT RELAY

- A. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual switching contacts; complying with UL 924.

1. Coil Rating: 120V or 277V as required per application.

2.7 CONDUCTORS AND CABLES

- A Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. Sensor locations shown on the drawings are to denote rooms that shall have sensor control. Provide sensors in locations and quantity as required by the manufacturer for proper coverage and operation of space.
- C. Provide all related parts and accessories for a complete and operational system.
- D. Install devices where indicated on the drawings. Provide all related parts and accessories for a complete working system.
- E. Install occupancy sensors in location to not interfere operation by other objects. Locate and aim sensors in correct location required for complete and volumetric coverage within the range of coverage's of controlled areas per the manufacturer's recommendations.
- F. Ceiling mounted occupancy sensors and daylight sensors shall be installed centered in ceiling tiles.
- G. Unless noted otherwise wall mounted switches shall be installed on the latch side of the door.
- H. Install daylighting sensors as indicated to control lamps as detailed on contract documents. Locate in ceiling to not interfere operation by other objects and as required by manufacturer to detect natural light levels. Set sensitivity levels for control as recommended by manufacturer.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

- B. Daylighting: Provide adjustments and calibration of the photocells utilized for daylighting controls. The photocells shall initiate control of the designated light fixtures in the identified spaces to operate as follows:
 - 1. The artificial lighting fixtures shall be dimmed or shut off when the ambient lighting level is 120 footcandles.
 - 2. The artificial lighting fixtures shall be re-energized or increased when the ambient lighting level is 40 footcandles.

3.7 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for lighting control system specified in Division 26 Section "Lighting Control Devices."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 260923

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - 1. Distribution transformers.

1.3 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Qualification Data: For testing agency.
- D. Source quality-control test reports: Certified copies of manufacturer's design and routine factory tests required by referenced standards.
- E. Sound-Level Test Reports: Certified copies of manufacturer's sound-level tests applicable for this Project.
- F. Field quality-control test reports: Indicate and interpret test results required in Part 3 of this section.
- G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 2. Square D; Schneider Electric.
 - 3. Siemens Energy & Automation, Inc.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Electrical grade Copper.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 250, Type 2 unless noted otherwise.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: ANSI 61 gray.
- E. Taps for Transformers Smaller Than 3 kVA: None.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 80 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- J. Wall Brackets: Manufacturer's standard brackets.
- K. Fungus Proofing: Permanent fungicidal treatment for coil and core.
- L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Division 26.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260573 - Overcurrent Protective Device Coordination Study.

1.2 SUMMARY

- A. This Section includes service and distribution switchboards rated 600 V and less.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes. Note that submittals cannot be approved prior to approval of the coordination study listed in Specification 260573.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of switchboards and overcurrent protective devices.
 - d. Descriptive documentation of optional barriers specified for electrical insulation and isolation.
 - e. Utility company's metering provisions with indication of approval by utility company.
 - f. Mimic-bus diagram.

- B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchboards; install electric heating (250 W per section) to prevent condensation.
- D. Handle switchboards according to NEMA PB 2.1 and NECA 400.

1.7 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Construction Manager and/or Owner in writing no fewer than ten days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Construction Manager and/or Owner written permission.

1.8 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 01.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Potential Transformer Fuses: Equal to 10 percent of amount installed for each size and type, but no fewer than 2 of each size and type.
 - 2. Control-Power Fuses: Equal to 10 percent of amount installed for each size and type, but no fewer than 2 of each size and type.
 - 3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.

4. Fuses for Fused Switches: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.
5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.
6. LED Indicating Lights: Equal to 10 percent of amount installed for each size and type, but no fewer than 1 of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MANUFACTURED UNITS

- A. Manufacturers:
 1. Eaton Corporation; Cutler-Hammer Products.
 2. Square D.
 3. Siemens Energy & Automation, Inc.
- B. Front-Connected, Front-Accessible Switchboard: Fixed, individually mounted main device, panel-mounted branches, and sections rear aligned.
- C. Nominal System Voltage: 208Y/120 V as indicated on the drawings.
- D. Main-Bus Continuous: 2000A, as indicated on the drawings.
- E. Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- F. Enclosure: Steel, NEMA 250, Type 1.
- G. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- H. Barriers: Between adjacent switchboard sections.
- I. Utility Metering Compartment: Fabricated compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.
- J. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- K. Removable, Hinged Rear Doors and Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard.

- L. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- M. Buses and Connections: Three phase, four wire, unless otherwise indicated.
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.
 - 2. Load Terminals: Insulated, rigidly braced, silver-plated, copper runback bus extensions equipped with pressure connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full ampere rating of circuit-breaker position.
 - 3. Ground Bus: 1/4-by-2-inch (6-by-50-mm) minimum-size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - 4. Contact Surfaces of Buses: Silver plated.
 - 5. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
 - 7. Neutral Buses: 100 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.
- N. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.3 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. IEEE C62.41, integrally mounted, plug-in-style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.
- B. Minimum single-impulse current rating shall be as follows:
 - 1. Line to Neutral: 240,000 A.
 - 2. Line to Ground: 125,000 A.
 - 3. Neutral to Ground: 125,000] A.
- C. Protection modes shall be as follows:
 - 1. Line to neutral.
 - 2. Line to ground.
 - 3. Neutral to ground.
- D. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.
- E. Maximum Category C combination wave clamping voltage shall not exceed 600 V, line to neutral and line to ground on 120/208 V.
- F. Maximum UL 1449 clamping levels shall not exceed 400 V, line to neutral and line to ground on 120/208 V.
- G. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in clamping voltage.

H. Accessories:

1. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.
2. Audible alarm activated on failure of any surge diversion module.
3. Six-digit transient-counter set to total transient surges that deviate from the sine-wave envelope by more than 125 V.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.

1. Electronic trip-unit circuit breakers shall have RMS sensing, field-replaceable rating plug, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, 100% trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator for circuit breakers 1,000A or greater.
4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
5. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.5 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondaries to ground overcurrent relays to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker ground-fault protection.

- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
 - i. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.
 - j. Total harmonic distortion.
 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
 3. BAC-NET Compatible

2.6 CONTROL POWER

- A. Control Circuits: 120 V, supplied through fused disconnecting devices.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Furnish one portable, floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.
- C. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.
- D. Fungus Proofing: Permanent fungicidal treatment for switchboard interior, including instruments and instrument transformers.

2.8 IDENTIFICATION

- A. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.2 EXAMINATION

- A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1 and NECA 40.
- B. Install and anchor switchboards level on concrete bases, 4-inch (100-mm) nominal thickness. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - 2. For switchboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- E. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.

- F. Install spare-fuse cabinet.

3.4 INSTALLATION OF SURGE PROTECTION DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install devices for panelboard and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide multipole, 60A circuit breaker as a dedicated disconnect for suppressor, unless otherwise indicated.

3.5 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.6 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
 - a. Provide testing for all main circuit breakers.
 - b. Provide testing for all circuit breakers with adjustable trip settings.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and/or front and rear panels so joints and connections are accessible to portable scanner.

b. Instruments, Equipment, and Reports:

- 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 2) Prepare a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260573 - Overcurrent Protective Device Coordination Study.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Transient voltage suppression panelboards.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes. Note that submittals cannot be approved prior to approval of the coordination study listed in Specification 260573.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.
- C. Qualification Data: For testing agency.
- D. Field quality-control test reports including the following:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- C. Product Options: Drawings indicate ratings, size, profiles, and dimensional requirements of panelboards and are based on the specific, fully rated, system indicated. Refer to Division 01.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2000 m).

- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Construction Manager/Owner no fewer than 10 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's/Owner's written permission.

1.7 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corporation; Cutler-Hammer Products.
 - b. Square D.
 - c. Siemens Energy & Automation, Inc.

 - 2. Transient Voltage Suppression Panelboards:
 - a. Eaton Corporation; Cutler-Hammer Products.
 - b. Square D.
 - c. Siemens Energy & Automation, Inc.

2.2 MANUFACTURED UNITS

- A. Enclosures: Flush- and surface mounted cabinets. NEMA PB 1, Type 1.
 - 1. Rated for environmental conditions at installed location.
 - a. Wet or Damp Indoor Locations: NEMA 250, Type 3R.
 - 2. Front: Secured to box with concealed trim clamps or bolted to panel tub. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Door in door; Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 5. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
 - 6. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.
- B. Phase and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
 - 3. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
 - 4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads where noted on drawings.
- C. Conductor Connectors: Suitable for use with conductor material.
 - 1. Main and Neutral Lugs: Mechanical type.
 - 2. Ground Lugs and Bus Configured Terminators: Mechanical type.
 - 3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

- A. Doors: Secured with vault-type latch with metal tumbler lock; keyed alike. Omit for fused-switch panelboards.

- B. Main Overcurrent Protective Devices: 100% rated circuit breaker.
- C. Branch Overcurrent Protective Devices:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
 - 3. Fused switches.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Concealed piano hinges; secured with metal flush latch with tumbler lock; keyed alike.

2.6 TRANSIENT VOLTAGE SUPPRESSION PANELBOARDS

- A. Doors: Secured with vault-type metal latch with tumbler lock; keyed alike.
- B. Main Overcurrent Devices: Thermal-magnetic circuit breaker.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.
- D. Bus: Copper phase and neutral buses; 200 percent capacity neutral bus and lugs where noted on drawings.
- E. Transient Voltage Suppression Device: IEEE C62.41, externally mounted, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.
 - 1. Minimum Single-Impulse Current Ratings:
 - a. Line to Neutral: 100,000 A.
 - b. Line to Ground: 100,000 A.
 - c. Neutral to Ground: 50,000 A.
 - 2. Protection modes shall be as follows:
 - a. Line to neutral.
 - b. Line to ground.
 - c. Neutral to ground.
 - 3. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.
 - 4. Maximum Category C Combination Wave Clamping Voltage: 600 V, line to neutral and line to ground on 120/208 V.
 - 5. Maximum UL 1449 Clamping Levels: 400 V, line to neutral and line to ground on 120/208 V and 800 V.
 - 6. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in clamping voltage.

7. Accessories:
 - a. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.
 - b. Audible alarm activated on failure of any surge diversion module.
 - c. Six-digit transient-counter set to total transient surges that deviate from the sine-wave envelope by more than 125 V.

2.7 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. GFCI Circuit Breakers: Single- and two-pole configurations with 30 mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings with feeder breakers 100% rated, and number of poles.
 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- D. Fuses are specified in Division 26 Section "Fuses."

2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Furnish portable test set to test functions of solid-state trip devices without removal from panelboard.
- C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Install overcurrent protective devices.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties upon completion of load balancing.

3.2 INSTALLATION OF SURGE PROTECTION DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install devices for panelboard and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide multipole, 60A circuit breaker as a dedicated disconnect for suppressor, unless otherwise indicated.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with self-adhesive laminated-plastic nameplate mounted.

3.4 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - a. Provide testing for all main circuit breakers.
 - b. Provide testing for all circuit breakers with adjustable trip settings.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Load Balancing: After Substantial Completion, but not more than 30 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
 - 1. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Wall-box motion sensors.
4. Isolated-ground receptacles.
5. Snap switches and wall-box dimmers.
6. Solid-state fan speed controls.
7. Wall-switch and exterior occupancy sensors.
8. Pendant cord-connector devices.
9. Cord and plug sets.
10. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

- B. Related Sections include the following:

1. Division 27 Section "Communications Copper Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Service/Power Poles: One for every 10, but no fewer than one.
 - 2. Floor Service Outlet Assemblies: One for every 10, but no fewer than one.
 - 3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two
 - 4. TVSS Receptacles: One for every 10 of each type installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 2. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL5351 (single), CR5352 (duplex).
 - b. Cooper; 5351 (single), 5352 (duplex).
 - c. Leviton; 5891S (single), 5352S (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).
- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; CR 5253IG.
 - b. Leviton; 5362S-IG.
 - c. Pass & Seymour; IG6300.
 2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed - through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell
 - b. Cooper; GF20.
 - c. Pass & Seymour; 2084.
 - d. Leviton

2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; IG2310.
 - b. Leviton; 2310-IG.
 - c. Pass & Seymour
2. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.5 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL1221 (single pole), HBL1222 (two pole), HBL1223 (three way), HBL1224 (four way).
 - b. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HPL1221PL for 120 V and 277 V..
 - b. Cooper; 2221PL for 120 V and 277 V
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL1221L.
 - b. Cooper; 2221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
2. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL1557.
 - b. Cooper; 1995.
 - c. Leviton; 1257.

F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL1557L.
 - b. Cooper; 1995L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.

2.8 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 - 1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "OFF."
 - 2. 1200 W; dimmers shall require no derating when ganged with other devices. Illuminated when "OFF."
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 1 percent of full brightness.
- E. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Lutron NovaT

2.9 FAN SPEED CONTROLS

- A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
 - 1. Continuously adjustable slider, 1.5 A.
 - 2. Three-speed adjustable slider, 1.5 A.

2.10 OCCUPANCY SENSORS

- A. Long-Range Wall-Switch Sensors:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATD1600WRP.
 - b. Leviton; ODW12-MRW.
 - c. Watt Stopper (The); DT-200.
 - 2. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft. (111 sq. m).
- B. Wide-Range Wall Sensors:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP120HBRP.
 - b. Lutron Equivalent
 - 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).
- C. Exterior Occupancy Sensors:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell

b. Lutron

2. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot (34-m) detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.11 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting or Smooth, high-impact thermoplastic 0.035 inch (1 mm) thick or satin-finished stainless steel 0.04 inch (1 mm) thick.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum or with lockable cover.

2.12 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Round, solid brass with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

2.13 POKE-THROUGH ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hubbell Incorporated; Wiring Device-Kellems.
 2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
 3. Square D/ Schneider Electric.
 4. Thomas & Betts Corporation.
 5. Wiremold Company (The).
- B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
 1. Service Outlet Assembly: Flush type with two simplex receptacles and space as noted on communications drawings.
 2. Size: As shown on drawings.
 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

2.14 MULTIOUTLET ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold Company (The).
- B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: Metal, with manufacturer's standard finish or PVC.
- D. Wire: No. 12 AWG.

2.15 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Utilized as Dedicated Computer Circuits: Gray.
 - 3. Wiring Devices Connected to Emergency Power System: Red.
 - 4. TVSS Devices: Blue.
 - 5. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
 - 5. Install switches on lock set side of doorways.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. Tighten unused terminal screws on the device.
8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 LOCATION OF DEVICES

- A. The approximate schematic location of devices is given on the drawings. The exact location shall be determined at the building as the work progresses. Refer to Architectural plans for any special details, elevations, and reflective ceiling plan. Verify door swings at job site. In no case shall switches be located behind door swings. Any switch so located shall be changed. Field

verify equipment locations and adjust device and outlet locations to avoid inaccessibility. Relocate inaccessible outlets.

- B. Unless otherwise indicated, or otherwise decided at the site, outlet boxes in walls shall be located with centerline at elevation above the finished floor as shown on table.
- C.

Wall Switch Outlets	4 feet
Convenience Outlets	1 foot 6 inches
Counter Outlets.....	8 inches above countertop
Desk Telephone Outlets	1 foot 6 inches
Wall Telephone Outlets	4 feet 6 inches
Telephone Outlets Above A Counter.....	8 inches above countertop
Public Telephone Outlets	Coordinate with telephone company
Plug In Strip	To be determined at the site
Exterior and Interior Wall Brackets.....	To be determined at the site
- D. The Architect and the Owner reserve the right to change the location of any outlet, before it has been installed.

3.3 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Dymo Posi Printer machine printing with black filled lettering on clear tape on face of plate.

3.4 FIELD QUALITY CONTROL

- A. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 5 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Division 01 and Division 26 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Cartridge fuses rated 600 V and less for use in switches, panelboards, switchboards, and controllers.
 - 2. Spare-fuse cabinets.

1.3 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 2. Let-through current curves for fuses with current-limiting characteristics.
 - 3. Time-current curves, coordination charts and tables, and related data.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 01, include the following:
 - a. Let-through current curves for fuses with current-limiting characteristics.
 - b. Time-current curves, coordination charts and tables, and related data.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA FU 1.
- D. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Quantity equal to 33 percent of each fuse type and size, but no fewer than 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussman, Inc.
 2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
 3. Ferraz Shawmut, Inc.
 4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.
- B. All fuses shall be indicator type employing either an indicator window or mechanical indicator striker pin.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

2.3 SPARE-FUSE CABINET

- A. Cabinet: Wall-mounted, 0.05-inch (1.27-mm) thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
1. Size: Adequate for storage of spare fuses specified with 3 fuse spare capacity minimum.
 2. Finish: Gray, baked enamel.
 3. Identification: "SPARE FUSES" in 1-1/2-inch (38-mm) high letters on exterior of door.
 4. Fuse Pullers: For each size of fuse.
- B. Cable limiter Fuses: Manufactured by Bussman; Shall be of the type to match system voltage, wire size and type, and configured with bolt and/or tube ends to match installation conditions. Limiters shall not permit more than 24,000 amps RMS and 55,000 amps peak under a 50,000 amps RMS short circuit condition.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Feeders: Class RK1, time delay.
- B. Motor Branch Circuits: Class RK1, time delay.
- C. Other Branch Circuits: Class RK1, time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers.
 - 4. Enclosures.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. HD: Heavy duty.
- C. RMS: Root mean square.
- D. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. UL listing for series rating of installed devices.
 - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring. Retain paragraph and subparagraphs below if required by seismic criteria applicable to Project.
- C. Qualification Data: For testing agency.

- D. Field quality-control test reports including the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Manufacturer's field service report.
- F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spares: For the following:
 - a. Potential Transformer Fuses: 3 of each size.
 - b. Control-Power Fuses: 4 of each size.
 - c. Fuses and Fusible Devices for Fused Circuit Breakers: 3 of each size.
 - d. Fuses for Fused Power Circuit Devices: 3 of each size.
 - 2. Spare LED Indicating Lights: 6 of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Square D/Group Schneider.
- B. Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Nonfusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
 - 3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open. Provide when used as remote disconnect for Variable Frequency Motor Controller circuits.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. Siemens Energy & Automation, Inc.
3. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. GFCI Circuit Breakers: Single- and two-pole configurations with 30 mA trip sensitivity.

C. Molded-Case Circuit-Breaker Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
6. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 01.

3.3 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.
 - 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.
- C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- D. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Infrared Scanning:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.

b. Instruments, Equipment and Reports:

- 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 2) Prepare a certified report that identifies enclosed switches and circuit breakers included and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges as noted in the Overcurrent Protective Device Coordination Study.

3.7 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816

SECTION 262923 – ADJUSTABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes solid-state, PWM, AFCs for speed control of three-phase, squirrel-cage induction motors and harmonic mitigation equipment.
- B. Related Sections include the following:
 - 1. Division 26 Section "Enclosed Switches and Circuit Breakers" for overcurrent protection and local disconnecting means.

1.3 RESPONSIBILITIES

- A. The AFC Manufacturer shall furnish the following:
 - 1. Complete AFC's ready for installation.
 - 2. A complete set of submittals.
 - 3. All engineering and installation services as described herein.
 - 4. All startup services.
 - 5. Instructions to the Owner.
 - 6. Owner's Manuals, complete operation instructions, and spare parts.
 - 7. A minimum two-year parts and labor warranty.
 - 8. Harmonic mitigation equipment shall reduce harmonics to five percent THD at the point of common coupling, the input of the AFC.
- B. The work by the Division 23 Contractor generally includes the following:
 - 1. Provide the AFC Manufacturer with a complete set of approved shop drawings for each pump and fan that will be driven by the AFC's. Shop drawings will include pump and fan curves with operating points designated and will also include the motor shop drawings. (V belt drive losses will be assumed to be in accordance with AMCA Standards for fans.)
 - 2. Provide all delivery and assembly work using appropriate tradesmen as required. In addition, if the AFC's require any assembly or are delivered in more than one piece per AFC, all assembly and wiring inside the cabinets shall be provided. This wiring shall not include wiring to external control devices that are provided by the building automation system supplier.
 - 3. Provide level housekeeping pads in accordance with the AFC Manufacturer's shop drawings.
 - 4. Provide all interconnecting control wiring between the AFC's and the building automation system.
 - a. Note all control wiring shall be tagged near terminal strip connections and checked by the AFC Manufacturer to verify proper connection to individual terminal strips.

5. Provide the Electrical Contractor with shop drawings of the AFC's for installation.
6. Provide the AFC Manufacturer with electrical single line drawings of the facility power distribution and other electrical data required for the AFC manufacturer's harmonic analysis.

C. The work by the Division 26 Contractor will include the following:

1. Once delivered to the site, provide all handling and installation of the AFC's and harmonic mitigation filter.
2. Provide all power wiring between the power sources and the harmonic mitigation filter, the AFC's and between the AFC's and the motors.

1.4 DEFINITIONS

- A. BMS: Building management system.
- B. IGBT: Integrated gate bipolar transistor.
- C. LAN: Local area network.
- D. PID: Control action, proportional plus integral plus derivative.
- E. PWM: Pulse-width modulated.
- F. AFC: Adjustable frequency controller.

1.5 SUBMITTALS

- A. Product Data: For each type of AFC and harmonics mitigation filter. Include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.
- B. Shop Drawings: For each AFC and harmonic filter.
 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current rating of integrated unit.
 - d. Features, characteristics, ratings, and factory settings of each motor-control center unit.
 2. Wiring Diagrams: Power, signal, and control wiring for AFCs. Provide schematic wiring diagram for each type of AFC.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around AFCs where pipe and ducts are prohibited. Show AFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

- D. Qualification Data: For manufacturer and testing agency.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For AFCs, installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for AFCs and installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- G. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain AFCs of a single type through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver AFCs and harmonic mitigation equipment in shipping splits of lengths that can be moved past obstructions in delivery path as indicated. Deliver VFC and associated harmonic mitigation equipment on one pallet.
- B. Store AFCs indoors in clean, dry space with uniform temperature to prevent condensation. Protect AFCs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: 0 to 40 deg C.
 - 2. Humidity: Less than 90 percent (noncondensing).
 - 3. Altitude: Not exceeding 3300 feet (1005 m).
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for harmonic mitigation filters, AFCs, including clearances between AFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.9 COORDINATION

- A. Coordinate layout and installation of AFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 07 Section "Cast-in-Place Concrete."
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."
- D. Coordinate features of AFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- E. Coordinate features, accessories, and functions of each AFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
 - 2. LED Indicating Lights: two of each type installed.

1.11 WARRANTY

- A. Warranty shall be 24 months from date of start-up or 30 months from delivery.
- B. Warranty shall include all parts, labor, travel, and living expenses for the entire period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (no substitutions):
1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.

2.2 ADJUSTABLE FREQUENCY CONTROLLERS

- A. Description: NEMA ICS 2, IGBT, PWM, AFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
1. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.
- B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- D. Unit Operating Requirements:
1. Input ac voltage tolerance of 208 V, plus or minus 5.
 2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
 3. Minimum Efficiency: 96 percent at 60 Hz, full load.
 4. Minimum Displacement Primary-Side Power Factor: 96 percent.
 5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
 6. Minimum Short Circuit Rating: 100,000 AIC RMS symmetrical at 480V.
 7. Starting Torque: 100 percent of rated torque or as indicated.
 8. Speed Regulation: Plus or minus 1 percent.
- E. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
1. Electrical Signal: 4 to 20 mA at 24 V.
- F. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 2 to a minimum of 22 seconds.
 4. Deceleration: 2 to a minimum of 22 seconds.
 5. Current Limit: 50 to a minimum of 110 percent of maximum rating.
- G. Self-Protection and Reliability Features:
1. Input transient protection by means of surge suppressors.
 2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

3. Motor Overload Relay: Solid State, adjustable and capable of NEMA ICS 2, selectable Class 10/20/30 performance.
 4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
 5. Instantaneous line-to-line and line-to-ground overcurrent trips (input circuit breaker).
 6. Loss-of-phase protection.
 7. Reverse-phase protection.
 8. Short-circuit protection.
 9. Motor overtemperature fault.
- H. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.
- I. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
- J. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
- K. Carrier Frequency: For the purposes of audio noise reduction in the driven motor, the AFC's carrier frequency shall be adjustable from .75 kHz up to a minimum of 15 kHz for all drive sizes in this specification. AFC's with fixed carrier frequency below 5 kHz will not be accepted.
- L. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- M. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- N. Input Line Conditioning: 3% Line Reactor for motors 15 HP and less; and Harmonic Mitigation Filter for motors 20 HP and above.
- O. The AFC's shall be able to operate with an IGBT switching frequency up to 15 kHz for drives below 30 hp, up to 10 kHz for drives greater than 30 hp up to 100 hp, and up to 6kHz for all drives over 100 hp. Drive shall be capable of producing continuous full load motor current as specified in NEC Table 430-250 across the entire switching frequency range.
- P. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.
 5. Overcurrent.
 6. External fault.
- Q. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

- R. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (VDC).
 9. Set-point frequency (Hz).
 10. Motor output voltage (V).
- S. Control Signal Interface:
1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
 - a. 0 to 10-V dc.
 - b. 0-20 or 4-20 mA.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 - e. RS485.
 - f. Keypad display.
 - 1) Keypad: AFC's shall have the same keypad/interface device capable of remote monitoring, control and a copy feature to copy parameter values from one controller to another. The keypad shall offer an alphanumeric LCD display that uses plain English for set-up, programming, and monitoring. A large four-digit LED display shall also be utilized to provide a readable display from a reasonable distance. The keypad shall use Hand-Off-Auto functionality to provide easy transfer from different operating modes. The keypad will offer one-touch speed set when operating in Hand mode. The AFC's shall provide the follow displays or meters:
 - a) Output frequency
 - b) Motor speed (RPM)
 - c) Motor speed (Percent)
 - d) Motor current
 - e) Motor power (KW)
 - f) DC bus voltage
 - g) Output voltage
 3. Output Signal Interface:
 - a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
 - 1) Output frequency (Hz).
 - 2) Output current (load).
 - 3) DC-link voltage (VDC).
 - 4) Motor torque (percent).

- 5) Motor speed (rpm).
 - 6) Set-point frequency (Hz).
4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set-point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.
 - T. Communications: Provide an RS485 interface, utilizing the ModBus RTU protocol, allowing AFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of AFC to be programmed via BMS control. Provide capability for AFC to retain these settings within the nonvolatile memory.
 - U. Bypass
 1. Three contactor bypass for 60 HP and above
 - a. Drive input, drive output, and bypass circuit contactors, sized per NEC and IEC ratings.
 - b. Control of the bypass shall utilize a large mimic diagram utilizing indicator lights for status and a switch for Inverter-Off-Bypass selection.
 - c. Bypass design must meet NEC Type II coordinated circuit configuration.
 2. Two contactor bypass with service switch for 50 HP and below
 - a. The service switch and bypass contactor shall electrically isolate the drive when operated.
 3. When AFD controller is placed in bypass mode, both the AFD and harmonic filter shall be bypassed.
 4. Harmonic mitigation equipment shall be bypassed when the AFD is operated in the bypass, across-the-line mode. Provide wiring terminals and space within the AFD enclosure to accommodate the wiring.
 - V. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker (100,000 AIC) with lockable handle.
 - W. Control Power: Internal 120 volt transformer for AFC's control.
 - X. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
- ### 2.3 ENCLOSURES
- A. NEMA 250, Type 1, steel enclosure to reduce EMI/RFI and insure protection from access to energized components.
- ### 2.4 ACCESSORIES
- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

- B. Control Relays: Auxiliary and adjustable time-delay relays.
- C. Standard Displays:
 - 1. Output frequency (Hz).
 - 2. Set-point frequency (Hz).
 - 3. Motor current (amperes).
 - 4. DC-link voltage (VDC).
 - 5. Motor torque (percent).
 - 6. Motor speed (rpm).
 - 7. Motor output voltage (V).
- D. Historical Logging Information and Displays:
 - 1. Real-time clock with current time and date.
 - 2. Running log of total power versus time.
 - 3. Total run time.
 - 4. Fault log, maintaining last four faults with time and date stamp for each.

2.5 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and tested AFCs before shipping.

2.6 HARMONIC MITIGATION FILTER

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mirus International, Inc., Model AUHF
 - 2. Trans-Coil, Inc., Model HG7 STM
- B. General
 - 1. AFC's of 20 hp and above shall be equipped with harmonic mitigation equipment to prevent power system problems resulting from high levels of harmonic distortion.
 - a. The harmonic mitigation equipment and all of its components shall be manufactured and tested in accordance with the latest applicable standards of UL, CSA, and NEMA.
 - b. Demonstration of compatibility between the harmonic mitigation equipment and the AFD must be available upon request.
 - c. Harmonic mitigation equipment shall be warranted to be free of defects in materials and workmanship for a period of 24 months from the date of startup or 30 months from the date of shipment.
 - d. Factory Performance Testing: Manufacturer must be capable of factory testing for harmonic mitigating performance and energy efficiency under actual variable frequency drive loads. A detailed description of the program and a sample test report must be provided at time of quotation.
- C. The harmonic mitigation equipment shall treat all of the characteristic low frequency harmonics generated by a 3-phase, diode bridge rectifier load (5th, 7th, 11th, 13th, etc.).

- D. The characteristic harmonics shall be suppressed without the need for individual tuning or the requirement to phase shift against other harmonic sources.
- E. Harmonic mitigation shall be by passive inductor/capacitor network or internal phase shifting transformer. Active electronic components shall not be used.
- F. Power factor shall be .98 lagging to .95 leading in operating range from full to half load.
- G. To ensure compatibility with engine generators, the harmonic mitigation equipment must never introduce a capacitive reactive power (KVAR) that is greater than 20% of its kVA rating below 100 HP and 15% at 100 HP and above or provide automatic capacitor disconnection prior to transfer switch transferring to emergency power.
- H. The harmonic mitigation equipment shall not resonate with system impedances or attract harmonic currents from other harmonic sources.
- I. The harmonic mitigation equipment in combination with the variable frequency drive shall meet all requirements as outlined in the 1992 edition of IEEE Standard 519 for individual and total harmonic voltage and current distortion. The point of common coupling (PCC) for all voltage and current harmonic calculation and measurements shall be the input terminals to the harmonic mitigation equipment.
- J. Total Harmonic Voltage Distortion (THVD) shall meet the requirements of Table 10.2 of IEEE Standard 519 by not exceeding 5% and by limiting the individual harmonic voltage distortion to less than 3%. These limits shall apply while operating on either utility supply or generator supply when applicable. The harmonic mitigation equipment vendor shall not be responsible for pre-existing voltage distortion caused by other harmonic sources.
- K. Total Demand Distortion (TDD) of the current at the input terminals of the harmonic mitigation equipment shall not exceed the limits as defined in Table 10.3 of IEEE Standard 519. For I_{sc}/I_L ratio <20 , TDD must be less than 5%. For all other I_{sc}/I_L ratios, the TDD must not exceed 8% even when Table 10.3 allows for more relaxed limits. For single-phase applications, the TDD must not exceed 12%.
- L. The full load efficiency of the harmonic mitigation equipment/AFD combination shall be greater than 96%. The harmonic mitigation equipment itself shall have efficiency no less than 99%.
- M. Basic Requirements
 - 1. All wiring shall be copper.
 - 2. Insulation class: 220°C system. Temperature rise: 130°C
 - 3. Anti-vibration pads shall be used between the reactor or transformer core and the enclosure.
 - 4. Ventilated, NEMA-1 enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive AFCs and harmonic filters for compliance with requirements, installation tolerances and other conditions affecting performance.

- B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before AFC and harmonic filter installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each AFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.
- B. Select horsepower rating and full load current of controllers to suit motor controlled.

3.3 INSTALLATION

- A. Anchor each AFC assembly and harmonic filter to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.
- B. Install AFC(s) and harmonic filter(s) on concrete bases.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

3.4 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Common Work Results for Electrical," and concrete materials and installation requirements are specified in Division 03.

3.5 IDENTIFICATION

- A. Identify AFCs, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."
- B. Operating Instructions: Frame printed operating instructions for AFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of AFC units.

3.6 CONTROL WIRING INSTALLATION

- A. Install wiring between AFCs and remote devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. If harmonic mitigation equipment utilizes capacitor automatic disconnect, provide signal to AFC to operate disconnect switch via the DDC system or the emergency power system.

- D. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
 - 3. The AFC manufacturer shall verify harmonic compliance with onsite field measurements of both the voltage and current harmonic distortion at the input terminals of the harmonic mitigating equipment with and without the equipment operating. A recording type Fluke 41 or equivalent harmonics analyzer displaying individual and total harmonic currents and voltages must be utilized.
 - 4. Report results in writing.

3.9 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 262923

SECTION 263010 – PHOTOVOLTAIC SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Division 01 and Division 26 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This specification is for supplying the engineering design and the material for the Photovoltaic Power (PV) System for the Montgomery College Science Center.
- B. This Section includes the following:
 - 1. PV Modules.
 - 2. Mounting Structure.
 - 3. Inverter.
- C. Scope of work for the Photovoltaic Power System equipment shall include providing all electrical components, engineering design, technical support, and construction supervision.
- D. The PV System shall be nominally 36KW actual power production, grid connected system without battery storage.
- E. The PV system shall be installed on the roof of the building. All the mounting structure shall be supplied and installed on the roof in an approved manner.
- F. The PV system shall be connected to the building power system and shall provide 480V, 3 phase power, in accordance with all the applicable codes and standards.
- G. Provide all necessary metering and connections required to operate with electric utility service company.
- H. Provide commissioning, training of college staff, and approval of the installed system.
- I. Provide a web interfaced monitoring system for the PV system to include displays of real time visual images, system performance data, and ambient weather parameters.
- J. All the roof penetrations on the building roof shall be approved by the certified roofing manufacturer or his authorized representatives. The installation shall be done in such a manner so that the roof warranty is not violated.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

B. Operation and Maintenance Data:

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - a. Provide electrical wiring diagram complete with quantity of photovoltaic array arrangements, wiring sizes, D.C. disconnect switches, Inverters and A.C. disconnect switches, by-pass diodes and ancillary interconnecting hardware and UV rated cables.
 - b. Provide all contractual documents required for utility service agreements to ensure appropriate permitting and financial arrangements are accomplished prior to project completion.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain photovoltaic panels from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Equipment and materials shall be new and the best quality produced by a manufacturer who has been regularly engaged in the manufacture of these products for a period of not less than 10 years.
- D. Material furnished shall be determined safe by a nationally recognized testing organization, such as Underwriters' Laboratories, Inc. or Factory Mutual Engineering Corporation, ETL and all materials shall be labeled, certified or listed by such organizations.
- E. Custom made equipment or related components which are constructed specifically for this project, the manufacturer shall certify the safety of the product on the basis of appropriate tests. The Equipment Manufacturer shall furnish copies of such certifications to the Owner.
- F. The PV system shall comply with the following standards:
 1. ASTM E1038-93, Test Method for Determining Resistance of PV Modules to Hail by Impact with Propelled Ice Balls.
 2. ASTM 1799-96, Practice for Visual Inspection of PV Modules.
 3. IEEE 928 Recommended Criteria for Terrestrial PV Power Systems.
 4. IEEE 929, Recommended Practice for Utility Interface of Residential and Intermediate PV Systems.
 5. IEEE P1262, Recommended Practice for Qualifications of PV Modules.
 6. IEEE P1373, Recommended Practice for Field Test Methods and Procedures for Grid Connected PV Systems.
 7. IEEE P1374 Guide for Terrestrial PV Power System Safety.
 8. ICE-904-1 Measurement of PV I-V Characteristics.
 9. ICE-1727 PV Characteristics for Utility Interface.
 10. UL-1703, Flat-Plate AV Module and Panels.
 11. UL-1741, Standard for Power Conditioner Units for Use in Residential PV Power Systems.
 12. IEEE 929-2000 Recommended Practice for Utility Interface of PV Systems.
 13. IEEE 1547: Standards for Interconnecting Distributed Resources with Electric Power Systems.

14. NFPA 70, including Articles 90-7, 690 and 705.
15. International Building Code.
16. IEEE 519-1992, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

1.5 COORDINATION

- A. Coordinate the installation of the photovoltaic system with the structural, roof, and electrical systems. Provide all necessary coordination with electric utility company to ensure utility service requirements are met and all agreements are in place to permit system tie-in with electric grid

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following.

2.2 PV MODULES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. SunPower
 2. Sanyo North America
 3. Canadian Solar
- B. The PV modules shall consist of single crystal silicon solar cells. An alternate price for multi-crystal solar cells shall also be provided.
- C. This document provides the required performance for PV modules of 293 watt DC nominal power. Modules of other power ratings may be used as long as appropriate equivalent performance is achieved.
- D. The nominal output power tolerance shall be $\pm 9\%$.
- E. The module shall include lightweight anodized aluminum frame with pre-drilled holes for quick installation.
- F. The solar module shall be completely framed with a high capacity, conduit-ready junction box.
- G. The modules shall either have terminal strips connections or weather proof polarized plugs.
- H. If the PV modules are to be used in a series and parallel arrangement, then bypass diodes must be provided to prevent reverse biasing the module, should some part of the module get shaded. This must be done in accordance with the manufacturer's recommendations.
- I. The modules shall be encapsulated in clear material on the front and rigid material on the back.
- J. Moisture shall not penetrate the module.

- K. The bidders shall connect the PV modules in the form of arrays. Provide complete details and wiring diagrams.
- L. The PV modules shall be warranted for twenty-five years.

2.3 MOUNTING STRUCTURE

- A. The mounting structure shall consist of anodized aluminum. The frame shall be suitable for mounting the proposed PV modules in the form of solar arrays.
- B. The slope of the PV arrays shall be selected to maximize yearly energy collection.
- C. The mounting structure shall withstand wind loading for the area, per the applicable building codes. The minimum wind loading shall be 50 PSF, and the wind speed of 120 mph or higher as required for the location.
- D. The structural support drawings for the system shall be stamped by a Professional Engineer registered in the state of Maryland.
- E. The bidders shall provide details of attaching the structure with the building roof.
- F. The structure that is proposed shall be in accordance with the PV module manufacturer's recommendations.
- G. Dissimilar metals shall not be used in any structural component.
- H. All mounting hardware shall be stainless steel.

2.4 INVERTER

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. SMA Sunnyboy
 - 2. Fronius
 - 3. Solectria
- B. This equipment shall be used to convert DC available from the PV array into 480V, three phase 60 Hz AC for connection with the college power system.
- C. The inverter shall be utility interactive, three-phase inverter. Exceptions to this requirement shall be explained in detail stating show the objective of three-phase inverter specification will be met.
- D. The inverter shall use advanced Maximum Power Point Tracking (MPPT), to maximize the available power from the PV array. The inverter output shall operate in parallel with the College's Power System.
- E. The equipment shall use insulated gate bi-polar transistors to reduce power losses during the conversion process.
- F. The equipment shall meet all applicable UL, IEEE and NEC code.

- G. The inverter shall have nominal 95% peak efficiency and the overall efficiency, including the transformer losses, the nominal efficiency shall be shall be greater than 93%.
- H. The equipment shall use digital signal processing, based controls with self-diagnostics, and LCD display of the operating status.
- I. The inverter shall be equipped with shut off and reset toggle switch.
- J. The equipment shall include over and under voltage and frequency protection shutdown in accordance with UL 1741.
- K. The equipment shall provide anti-islanding protection to prevent back feeding inverter generated power to the grid in the event of a utility outage.
- L. The equipment shall include graphical user interface software for real time communications and control. The output signals for the PV inverter shall include instantaneous AC power, daily total energy produced, total year to date energy, instantaneous conversion efficiency from solar to electric, etc.
- M. The (nominal) technical specification for a 36 KW (nominal) inverter are as follows:
 - 1. Continuous rating AC 36 KW
 - 2. Normal AC voltage 480 V (Three-phase $\pm 10\%$)
 - 3. Frequency 60Hz + 0.5
 - 4. Line power factor above 20% rated power >0.99
 - 5. Maximum AC line current 109 amps
 - 6. AC current distortion at rated power < 5% THD
 - 7. Maximum open circuit voltage 600V DC
 - 8. Power tracking window range 330 to 600 VDC
 - 9. Maximum DC current input 109 amps
 - 10. Maximum ripple current percentage of rated current peak inverter <5%
 - 11. Peak inverter efficiency (nominal) >95%
 - 12. Standby tare losses <30W
 - 13. Ambient temp range -4°F to 122°F.
 - 14. Enclosure rating NEMA 4
 - 15. Cooling forced convection
 - 16. Protective functions: Standard wake up voltage, wake-up time delay, shutdown power, shutdown time delay, AC over/under voltage and time delay, AC over and under frequency and time delay, ground over current, over temperature, AC and DC over current, DC over voltage.
 - 17. Display standard LCD 20 characters, on/off toggle switch
 - 18. AC disconnect: Wall mounted enclosure, load break rated.
 - 19. Serial communication and software shall be provided for interfacing with the web. Connect communication interface with IP device. Provide appropriate software to use.
- N. The equipment warranty shall be 5 years minimum.

PART 3 - EXECUTION

3.1 GENERAL

- A. The project is based on performance specifications. Provide a complete design that meets the performance specifications listed in the project documents.

- B. Provide suitable guidance for the building information display system installation for specialized equipment as necessary.
- C. Provide the required information in a usable form per the project documents.

3.2 PHOTOVOLTAIC INTERFACE DISPLAY SYSTEM

- A. This section provides information about the work that will be provided in coordination with the owners building system information display systems.
- B. The work to be provided includes the following:
 - 1. Provide display in the lobby to display the following quantities:
 - a. Ambient temperature
 - b. Solar radiation in the plane of the PV array.
 - c. Instantaneous AC power produced by the PV array.
 - d. Daily total energy produced by solar PV.
 - e. Total year-to-date energy free solar.
 - f. Instantaneous conversion efficiency from solar to electric.
 - g. Total year-to-date mitigation of relevant pollutants such as NOX, SOX, CO2, and particulates affected by the PV system.
 - 2. The performance of the array system shall be available over the web. The web site for this purpose shall be developed by the Owner's consultant.

3.3 IDENTIFICATION

- A. Install equipment labels on all devices.

END OF SECTION 263010

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets for standby power supply with the following features:
 - 1. Diesel engine.
 - 2. Unit-mounted cooling system.
 - 3. Unit-mounted control and monitoring.
 - 4. Performance requirements for sensitive loads.
 - 5. Outdoor enclosure.
- B. Related Sections include the following:
 - 1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 4. Wiring Diagrams: Power, signal, and control wiring.
 5. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 6. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Qualification Data: For manufacturer and testing agency.
- D. Source quality-control test reports.
1. Certified summary of prototype-unit test report.
 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 5. Report of sound generation.
 6. Report of exhaust emissions showing compliance with applicable regulations.
 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles (321 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing

Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with ASME B15.1.
- G. Comply with NFPA 37.
- H. Comply with NFPA 70.
- I. Comply with NFPA 99.
- J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- K. Comply with UL 2200.
- L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- M. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
1. Notify Construction Manager and/or Owner, in writing, no fewer than ten days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Construction Manager's and/or Owner's written permission.
- B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
1. Ambient Temperature: 5 to 40 deg C.
 2. Relative Humidity: 0 to 95 percent.
 3. Altitude: Sea level to 1000 feet (300 m).

1.7 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: Two years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include 24 hours per day, (7) seven days per week on-call repair service.
- B. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kohler Co.; Generator Division.
 - 2. Caterpillar; Engine Div.
 - 3. Onan/Cummins Power Generation; Industrial Business Group.
 - 4. MTU/Detroit Diesel.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, EPA Tier III engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Fuel oil, Grade DF-2.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

- E. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- F. Governor: Adjustable isochronous, with speed sensing.
- G. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
 - 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 - 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- H. Muffler/Silencer: Critical type, and flexible connector, enclosed within engine generator housing, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 - 1. Minimum sound attenuation of 25 dB at 500 Hz.
 - 2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.
- I. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- J. Starting System: 12 V electric, with negative ground.
 - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 - 3. Cranking Cycle: 60 seconds.
 - 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
 - 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 - 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.

7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
 1. Tank level indicator.
 2. Capacity: 24 hours of full power operation.
 3. Vandal-resistant, fill cap.
 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

- C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.
 - 6. Engine lubricating-oil pressure gage.
 - 7. Running-time meter.
 - 8. Ammeter-voltmeter, phase-selector switch(es).
 - 9. Generator-voltage adjusting rheostat.
 - 10. Fuel tank derangement alarm.
 - 11. Fuel tank high-level shutdown of fuel supply alarm.
 - 12. Generator overload.
- E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
 - 1. Overcrank shutdown.
 - 2. Coolant low-temperature alarm.
 - 3. Control switch not in auto position.
 - 4. Battery-charger malfunction alarm.
 - 5. Battery low-voltage alarm.
 - 6. Low coolant level.
- G. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation. Mounted adjacent to generator transfer switches.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
 - 1. Tripping Characteristic: Designed specifically for generator protection.
 - 2. Trip Rating: Matched to generator rating.
 - 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

4. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Drip-proof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
 2. The regulator shall include electronic build-up and overcurrent protection. It shall incorporate 1:1 volts per hertz characteristics with the regulated voltage a linear function proportional to frequency over a 30 to 70 hertz range.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Sound attenuated, enclosed muffler, vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
- B. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
 - 1. AC lighting system and connection point for operation when remote source is available.
 - 2. DC lighting system for operation when remote source and generator are both unavailable.
- C. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.9 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - 1. Housing: Steel with resilient vertical-limit stops; factory-drilled baseplate bonded to 1/4-inch (6-mm) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.10 FINISHES

- A. Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.11 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator with restrained spring isolators having a minimum deflection on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.
- D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
- E. Provide initial fuel fill to perform generator tests and re-fill fuel tank, once testing is complete.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 - 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 - 6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 - 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 - 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 - 9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 - 10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations along the property line of the site, and compare measured levels with required values.
- E. Coordinate tests with tests for transfer switches and run them concurrently.
- F. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

- G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- J. Remove and replace malfunctioning units and retest as specified above.
- K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- M. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 263213

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.
 - 2. Bypass/isolation switches.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- C. Qualification Data: For manufacturer and testing agency.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:
 - 1. Features and operating sequences, both automatic and manual.
 - 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing

Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
 2. Source Limitations: Obtain automatic transfer switches, bypass/isolation switches through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA ICS 1.
- E. Comply with NFPA 70.
- F. Comply with NFPA 99.
- G. Comply with NFPA 110.
- H. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
1. Notify Construction Manager and/or Owner, in writing, no fewer than ten days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Construction Manager's and/or Owner's written permission.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 01.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Contactor Transfer Switches:
 - a. Eaton Electrical Inc.; Cutler-Hammer.
 - b. Emerson; ASCO Power Technologies, LP.
 - c. Russelectric, Inc.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
 - 2. Transfer switches shall have a three cycle closing and withstand rating of 22,000 RMS symmetrical amperes at 208 volts.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switch Action: Double throw; mechanically held in both directions.
 - 2. Contacts: Silver composition or silver alloy for load-current switching.
- G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles or overlapping neutral contacts.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- J. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.

- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- G. Automatic Transfer-Switch Features:
 - 1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 - 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 - 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 - 4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 - 5. Test Switch: Simulate normal-source failure.
 - 6. Switch-Position LED Pilot Lights: Indicate source to which load is connected.
 - 7. Source-Available LED Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green LED light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red LED light with nameplate engraved "Emergency Source Available."
 - 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 - 9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. LED pilot light indicates override status.
 - 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 - 11. Auxiliary Contacts: Position of transfer switch (normal/emergency), Position of Maintenance bypass switch, Advanced transfer.
 - 12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

2.4 BYPASS/ISOLATION SWITCHES

- A. Comply with requirements for Level 1 equipment according to NFPA 110.
- B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
 - 1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.
 - 2. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations.
 - 3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
 - 4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
 - 5. LED Indicating Lights: Indicate source to which load is connected and to indicate switch is in bypass position.
 - 6. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less by means of a second, externally operated handle.
 - 7. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
 - 8. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
- C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.5 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

- B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- C. Identify components according to Division 26 Section "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
 - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 - 5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

- b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 micro-ohms and values for 1 pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- D. Testing Agency's Tests and Inspections:
 1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 micro-ohms and values for 1 pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- E. Coordinate tests with tests of generator and run them concurrently.
- F. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- G. Remove and replace malfunctioning units and retest as specified above.
- H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."
- B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a functional and unobtrusive lightning protection system in accordance with the provisions of the latest "Code for Protection Against Lightning" for buildings as adopted by the National Fire Protection Association and the Underwriters Laboratories, Inc. for a Master Label System.
- B. If any departures from the contract drawings are deemed necessary, details of such departures shall be submitted as soon as practicable to the Architect for approval. No such departures shall be made without the prior written approval of the Architect.
- C. This is a performance specification. The lightning protection system shall be designed and installed by a Lightning Protection Contractor who specializes in this field.
- D. The following specifications and standard of the latest issue form a part of this specification:
 - 1. Lightning Protection Institute Installation Code LPI-175
 - 2. National Fire Protection Association Code No. 780 (2011 edition)

1.3 DEFINITIONS

- A. LPI: Lightning Protection Institute.
- B. NRTL: National recognized testing laboratory.

1.4 SUBMITTALS

- A. Product Data: For air terminals and mounting accessories.
- B. Shop Drawings: Detail lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
- C. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include data on listing or certification by an NRTL or LPI.
- D. Certification, signed by Contractor, that roof adhesive for air terminals is approved by manufacturers of both the terminal assembly and the single-ply membrane roofing material.

- E. Field inspection reports indicating compliance with specified requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is an NRTL or who is certified by LPI as a Master Installer/Designer.
- B. Listing and Labeling: As defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ERICO International Corporation.
 2. Heary Bros. Lightning Protection Co. Inc.
 3. Thompson Lightning Protection, Inc.

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96.
- B. Roof-Mounting Air Terminals: NFPA Class I, aluminum, solid, unless otherwise indicated.
 1. Single-Membrane, Roof-Mounting Air Terminals: Designed for single-membrane roof materials.
- C. Stack-Mounting Air Terminals: Stainless steel.
- D. Ground Rods, Ground Loop Conductors, and Concrete-Encased Electrodes: Comply with Division 26 Section "Grounding and Bonding for Electrical Systems" and with standards referenced in this Section. Copper.
- E. All materials shall be copper or aluminum as described below and of the size, weight, and construction to suite the application where used in accordance with LPI and NFPA code requirements for Class II structures and as per manufacturer recommendations.

- F. Downlead conductors from roof to ground shall be tinned copper of 28 strands 14 gauge minimum, Thompson Catalog No. 506T. All main roof conductors shall be aluminum of 37 strands 13 gauge minimum, Thompson Catalog No. A37.
- G. Air terminals shall be solid, round aluminum bar of 5/8 inch minimum diameter, Catalog No. A665, etc., and shall project 10 inches minimum above the object to be protected. Locate and space according to LPI and NFPA requirements.
- H. Air terminal bases shall be of cast aluminum with bolt pressure cable connections and shall be securely mounted with stainless steel screws or bolts. Crimp type connectors are not acceptable. Thompson Catalog No. A680, A678, A78, A611, etc., as required.
- I. Bases on EPDM rubber roofs shall be secured with the applicable pourable sealer and shall have a minimum surface contact area of 18.5 square inches, Catalog No. A688, etc.
- J. All bases for equipment shall be securely mounted to roof, parapet, etc., as directed by roofing manufacturer, and all sealers, compounds, etc., shall be compatible with roofing materials.
- K. Ground rods shall be a minimum 3/4 inches in diameter and 10 feet long. They shall be connected to the system with a two-bolt cast bronze clamp, No. 519 having a minimum length of 1-1/2 inches and employing stainless steel cap screws.
- L. Cable fasteners shall be substantial in construction, electrolytically compatible with the conductor and mounting surface and shall be spaced according to LPI and NFPA code requirements. Thompson Catalog No. A174, A730, or A166, etc.
- M. Bonding devices, cable splicers, and miscellaneous connectors shall be of cast aluminum with bolt pressure connections to cable. Cast or stamped crimp fittings are not acceptable. Splicers similar to Catalog No. A423, A705, A706, etc.; bonding devices similar to Catalog No. A702, A704, A551, A142, A561, A561X, A142X, etc.
- N. Equipment on stacks and chimneys shall be protected from corrosion in accordance with LPI and NFPA requirements.
- O. All miscellaneous bolts, nuts, and screws shall be stainless steel.
- P. An approved bi-metal transition fitting shall be used at the roof level to change from aluminum roof conductor to copper downlead cable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops.
- C. Conceal the following conductors:
 - 1. System conductors.
 - 2. Down conductors.
 - 3. Interior conductors.

4. Conductors within normal view from exterior locations at grade within 200 feet (60 m) of building.
 5. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- D. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.
- E. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
- F. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.
- G. A counterpoise installation based on requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" may be used as a ground loop required by NFPA 780, provided counterpoise conductor meets or exceeds minimum requirements in NFPA 780.
1. Bond ground terminals to counterpoise conductor.
 2. Bond grounded metal bodies on building within 12 feet (3.6 m) of ground to counterpoise conductor.
- H. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

3.2 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL

- A. UL Inspection: Provide inspections as required to obtain a UL Master Label for system.

END OF SECTION 264113

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. CU: Coefficient of utilization.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.
- G. RCR: Room cavity ratio.
- H. Fixture: A complete lighting unit, exit sign, or emergency lighting unit. Fixtures include lamps and parts required to distribute the light, position and protect lamps, and connect lamps to the power supply.
- I. Modified Standard: A manufacturer's standard product that has been modified in any manner to conform to the specified fixture and these specifications
- J. Custom Fixture: Any fixture that is not a standard product of the specified manufacturer that is constructed to conform to the design and specifications shown.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.

2. Emergency lighting units including battery and charger.
 3. Ballast.
 4. Energy-efficiency data.
 5. Life, output, and energy-efficiency data for lamps.
 6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
 - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Shop Drawings: Show details of modified standard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
1. Wiring Diagrams: Power and control wiring.
- C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Lighting fixtures.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems for lighting fixtures will be attached.
 4. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Access panels.
 5. Perimeter moldings.
- D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:
1. Lamps: Specified units installed.
 2. Accessories: Cords and plugs.
- E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- F. Qualification Data: For agencies providing photometric data for lighting fixtures.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

- J. Lamps for each fixture type.
- K. Ballasts for each fixture type.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.
- D. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of fixtures for mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Fixtures for use in insulated ceilings shall be IC-rated if insulation comes within 3" of sides of fixture housings, or within 6" of the top of fixture housings.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, structural steel members, and partition assemblies.
- B. For fixtures installed in hard ceilings, provide plaster rings if required.
- C. Fixtures installed in casework or custom millwork shall be coordinated with casework supplier. Fixture dimensions and wiring shall be coordinated prior to installation and fabrication of casework or custom millwork.
- D. Coordinate lengths of all undercabinet/task lighting with casework or millwork drawings. Verify with drawings if lighting shall be cord and plug or hardwired prior to ordering.

1.7 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
- B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
- C. Special Warranty for T5 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 5 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Battery and Charger Data: One battery for each type installed.
 - 4. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Lighting fixtures shall be provided from the manufacturers listed in the Lighting Fixture Schedule as part of the contract drawings.
- B. Where more than one manufacturer is listed the first manufacturer is the basis of design. Alternate manufacturers are listed as potential sources of product equal to the basis of design. Listing of alternate manufacturers does not guarantee that an equal product is available as a standard product offering. A custom or modified version of a standard product, provided by one of the alternate manufacturers and a level of quality established by the standard series shown, will be reviewed for approval. Product will be accepted if technical specifications as well as

aesthetic qualities meet or exceed those of the specified manufacturer. The architect reserves the right to reject or modify the proposed fixture from the alternate manufacturer as needed to match the specifications of the fixture chosen as the basis of design.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. All sheet metal work shall be free from tool marks, dents, and burrs. Unless otherwise indicated all sheet metal shall be a minimum of #20 gauge cold rolled sheet steel. Bent angles shall be formed as sharp as compatible with the gauge of the steel. All intersections and joints shall be formed true and of adequate strength and structural integrity to prevent any distortion after assembly. Edges of sheet metal components shall be finished such that no sharp edges are exposed. Splices and or filler pieces used to cover poor or defective workmanship will not be accepted. All sheet metal components shall be free of light leaks.
- B. Ferrous mounting hardware and accessories shall be finished using either a galvanic or phosphate primer/baked paint process to prevent corrosion and discoloration of adjacent materials.
- C. Hardware for steel and aluminum fixtures shall be cadmium or equivalent plated. Hardware for stainless steel fixtures shall be stainless steel. Hardware for bronze fixtures shall be stainless steel or bronze.
- D. Acrylic lenses and diffusers shall be formed of colorless 100% virgin acrylic plastic. Acrylic plastic lenses and diffusers shall be properly cast, molded, or extruded as specified, and shall remain free of any dimensional instability, discoloration, embrittlement, or loss of light transmittance for a period of 15 years. Acrylic lenses shall be a minimum of 0.125" pattern #12 acrylic.
- E. Vandal resistant lenses shall be formed from ultraviolet (UV) stabilized polycarbonate.
- F. Glass used for lenses, refractors, and diffusers in incandescent light fixtures shall be tempered for high impact and heat resistance. Glass shall be crystal clear in quality and not less than 88% transmittance.
- G. Glass for exterior fixtures shall be tempered Borosilicate glass equal to Corning #7740 or as specified in fixture schedule.
- H. Reflectors shall be formed sheet aluminum in a specular, semi-specular, or diffused finish as indicated in fixture schedule. Alzak reflectors shall be guaranteed against discoloration for a period of ten years.
- I. All doors, frames, and other internal access shall be smooth operating and free from light leakage on all sides of the fixture under operating conditions.
 - 1. All general purpose troffers shall have spring-loaded cam latch doors. Provide gasketing or mechanical light leak protection on all sides of the fixture.
 - 2. All recessed downlights and wallwashers shall have metal trim rings.
- J. Fixtures installed in gypsum board ceilings or plaster ceilings shall be provided with plaster frames. Plaster frames shall be braced temporarily to prevent distortion during installation.
- K. All fixtures shall be furnished with all internal wiring completed by the manufacturer.

- L. Linear pendant mounted fixtures shall have one feed point per run with quick disconnect fittings between adjacent fixtures.
- M. All lamp sockets in fixtures shall be suitable for the intended lamps and shall be installed such that the lamps are positioned in the optically correct relationship to all fixture components. If adjustable socket positions are provided, sockets shall be preset in the factory for the specified lamp. If different socket positions are specified for the same fixture, sockets shall be preset for each type and the cartons marked accordingly.
- N. Adjustable lamp fixtures shall have a positive locking mechanism for fixing the beam angle once all adjustments are complete.
- O. Fixtures with double-ended fluorescent lamps and ballast shall contain an internal disconnecting means to isolate the line side terminals from the source.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. Electronic Ballasts: Comply with ANSI C82.11; designed for type and quantity of lamps served. Use programmed start type ballasts for any fixtures connected to occupancy sensors. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.
 - 1. Sound Rating: A
 - 2. Total Harmonic Distortion Rating: Less than 10 percent.
 - 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 - 4. Operating Frequency: 40 kHz or higher without visible flicker.
 - 5. Lamp Current Crest Factor: 1.7 or less.
 - 6. BF: 0.88 or higher.
 - 7. Power Factor: 0.95 or higher.
 - 8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
 - 9. Manufacturer:
 - a. Advance – Optanium Programmed Start (PS)
- B. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.
- C. Fixtures with double ended fluorescent lamps and ballast shall contain an internal disconnecting means to isolate the line side terminals from the source
- D. Ballasts for Low-Temperature Environments:
 - 1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
 - 2. Manufacturer:
 - a. Advance – Optanium Low Temp Start
- E. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
 - 1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 - 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 - 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

4. Manufacturer:

- a. Lutron

F. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 50 percent of rated lamp lumens.
2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.
4. Manufacturer:
 - a. Advance – Optanium Programmed Start (PS)

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
11. Ballast Case Temperature: 75 deg C, maximum.
12. Manufacturer:
 - a. Advance – Optanium Programmed Start (PS)

B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
4. Manufacturer:
 - a. Lutron

2.5 BALLASTS FOR HID LAMPS

- A. Electronic Pulse Start Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
1. Lamp end-of-life detection and shutdown circuit.
 2. Sound Rating: A.
 3. Total Harmonic Distortion Rating: Less than 15 percent.
 4. Transient Voltage Protection: IEEE C62.41, Category A or better.
 5. Lamp Current Crest Factor: 1.5 or less.
 6. Power Factor: .90 or higher.
 7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 8. Protection: Class P thermal cutout.
 9. Manufacturer:
 - a. Advance – Pulse Start Metal Halide

2.6 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction and as specified in fixture schedule.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 2. Die-cast Aluminum Exit Signs shall be provided with a universal mounting bracket, suitable for end, top, or back mount.
 3. Edge-Lit Exit Signs shall be provided with a recessed housing. Panels shall be injection-molded clear acrylic with a mirrored face.

2.7 FLUORESCENT LAMPS

- A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T5 rapid-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches (1150 mm), 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated. Additional wattages and lengths as indicated in fixture schedule and as required for specified fixture.
- C. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated. Additional wattages and lengths as indicated in fixture schedule and as required for specified fixture.
- D. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.
1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).

5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

E. Manufacturers: All lamps to be by the same manufacturer.

1. Phillips
2. General Electric

2.8 HID LAMPS

A. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 4000 K.

B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

D. Manufacturers: All lamps to be by the same manufacturer.

1. Phillips
2. General Electric

2.9 LIGHT EMITTING DIODES

A. High brightness LED's with luminous flux range of 62.0 to 84.0, depending upon the specified color temperature for the fixture type.

B. Integral or remote driver, dependent upon the fixture type.

C. Electrical and photometric performance of the solid state sources shall meet the approved method for testing of electrical and photometric measurements of solid-state lighting products, IES LM-79-08.

D. Manufacturers:

1. CREE
2. Lamina
3. Phillips
4. General Electric
5. OSRAM Sylvania

2.10 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).
- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.11 LIGHTING SHEILDING FOR ARCHITECTURAL COVES

- A. Provide a continuous line of aluminum parabolic baffle along the entire length of the architectural coves in the restrooms.
- B. Aluminum parabolic baffles shall be formed to precise parabolic contours.
- C. Baffle height shall be 3/4", spaced 3" on center, 12" width with flange edge (for support by L bracket). The assembly shall be free of breaks in alignment.
- D. Finish shall be semi-specular silver.

2.12 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

- A. See lighting fixture schedule included as part of contract drawings for requirements for individual fixtures.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to architectural reflected ceiling plans, elevations and section drawings for exact locations of fixtures. Do not scale the electrical drawings for exact locations of the lighting fixtures.
- B. Furnish lighting fixtures complete with all appurtenances required for the proper, safe, and distortion-free installation in the various surfaces in which they appear. Determine surface types from the architectural drawings.
- C. Fixtures shall be installed in accordance with Article 410 of the National Electrical Code.
- D. All fixtures in a given area shall have all visible components, lamps, baffles, lenses, etc., oriented in the same direction.
- E. Fixtures installed in wet locations shall have a continuous bead of silicon caulking around the fixture housing, door frame, and interface to the ceiling. Fixtures shall be tested and all lamps replaced and new caulking shall be installed prior to final commissioning of animal holding areas. During this process all failed gaskets shall be replaced.
- F. Fixtures shown in mechanical rooms are for quantity only. Coordinate exact mounting locations with other trades prior to installation. Fixtures shall be installed in such locations to properly illuminate walking areas, equipment, displays and gauges, and servicing areas. Provide metal hangers and threaded rod as required.

- G. Surface mounted fixtures shall be installed level, plumb, and square with respect to ceilings and walls. Fixtures shall be secured according to the manufacturer's written instructions and approved submittal materials.
- H. Fixtures noted as installed in a grid ceiling shall be installed in the center of a ceiling tile, unless noted otherwise.
- I. Fixtures recessed in grid ceilings shall be supported independent of the ceiling system. Fixtures shall be supported as follows:
 - 1. For nominal fixture sizes, 2x4, 2x2, and 1x4, provide a minimum of four support rods or wires, minimum 12 gauge wire, for each fixture. Wires shall be located not more than 6" from fixture corners. Wires shall be installed such that the fixture is supported from the building structure and not from the grid ceiling.
 - 2. Provide support clips as required to fasten fixtures to the ceiling grid members in addition to supporting the fixture from the building structure.
 - 3. Fixtures of sizes less than the structural grid shall be installed with a minimum of two $\frac{3}{4}$ " metal channels spanning and secured to the structural grid. Metal channels shall also be supported from the building structure with a minimum of #12 gauge wire, with a minimum of one support per fixture.
- J. Fixtures recessed in hard ceilings shall be installed with aperture and/or trim rings flush to the underside of the ceiling system. Cut-outs for fixtures shall be coordinated with fixture aperture size such that the trim ring will cover the cut-out in its entirety.
- K. Fixtures recessed in ceilings with a fire rating of one hour or more shall be enclosed in a box which has a fire resistance rating equal to that of the ceiling.
- L. Fixtures installed surface mounted to a grid ceiling shall be supported from structural members independent of the grid ceiling.
- M. Pendant mounted strip fixtures, industrial reflectors, or lensed wrap-around fixtures shall be installed with a minimum of two supports per 4' section or three supports per 8' section.
- N. Pendant mounted indirect fixtures shall be installed as follows:
 - 1. Pendants in rows shall be installed straight, level and in a continuous row. Cable fixture pendants shall be adjustable for field leveling of fixture.
 - 2. Pendants shall be connected to the ceiling grid via appropriate hardware systems. For pendants on the grid-line utilize a T-bar mounting bracket attached to the ceiling system T-bars at each fixture pendant equal to Caddy IDS clip. For pendants installed off the grid-line a hanger bar equal to Caddy #512HD shall be used.
 - 3. In all instances pendant mounted fixtures shall be supported from the structure above with #12 gauge wire. Fixtures shall be tied to the structure above at every connection point to the ceiling grid system with 2 support wires. Support wires shall be angled at approximately 45 degrees to structure above and spaced 180 degrees apart. Fixtures installed on hard ceilings shall have the junction box supported rigidly from the structure above.
 - 4. Power feeds shall be installed at the ends of rows, unless multiple feed points are required based on row length. Power feeds shall be SO cord, fastened to the aircraft cable by tie-wraps at no less than 6" intervals. Power cord shall be installed straight and without any kinks, twists, or slack cable below the ceiling.
- O. All fixtures shall be installed with the proper lamps as described in the Lighting Fixture Schedule. All lamps shall be operational after installation is complete.

- P. Emergency Lighting Units shall be installed unswitched on the circuit indicated on the drawings.
- Q. Battery Powered Exit Signs shall be installed unswitched on the circuit indicated on the drawings.

3.2 ELECTRICAL CONNECTIONS

- A. All fixtures shall be grounded in accordance with Article 250 of the National Electrical Code.
- B. Fixture connections shall be made via flexible conduit from the junction box to the fixture, length not to exceed 6'. Direct wiring between fixtures shall not be permitted.
- C. All low voltage wiring shall be as recommended by the fixture manufacturer. Low voltage wiring shall be a minimum of #12 AWG copper conductors. Voltage drop shall not exceed 5% of nominal voltage, increase wire size as required.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage including but not limited to, scratches, dents, defective parts, cracked lenses, etc. Replace damaged fixtures and components as required.
- B. Test and inspect all fixtures connected to the emergency generator system. Provide advance notice of the test to the architect. Testing procedure shall be as follows:
 - 1. Verify normal operation of each fixture.
 - 2. Interrupt normal electrical supply to demonstrate proper transfer to emergency power.
 - 3. Check intensity and uniformity of illumination with a photometer calibrated to NIST standards.
 - 4. Verify all exit signs are properly illuminated to comply with NFPA 101 requirements.
 - 5. Retransfer power source to normal power.
- C. Test and inspect all emergency battery units and battery ballasts. Provide advance notice of the test to the architect. Testing procedure shall be as follows:
 - 1. Verify normal operation of each fixture.
 - 2. Interrupt normal electrical supply to demonstrate proper transfer to battery power.
 - 3. Check intensity and uniformity of illumination with a photometer calibrated to NIST standards for initial illumination and for illumination after 90 minutes of battery operation.
 - 4. Verify aiming of lamps, to properly illuminate the path of exit.
 - 5. Verify all exit signs are properly illuminated to comply with NFPA 101 requirements for a period of 90 minutes.
 - 6. Retransfer power source to normal power.

3.4 AIMING AND ADJUSTING

- A. Fixtures shall be installed with fixtures aimed in the intended direction. Wall mounted indirect fixtures shall be aimed to illuminate the ceiling. Wall washers shall have reflectors oriented towards the intended wall. Track lighting shall have all heads oriented in the same direction.
- B. Provisions shall be made for final aiming of all adjustable fixtures prior to the project being turned over to the owner. Provisions shall be made for aiming of fixtures in hard to reach places or fixtures installed in multi-story spaces. Lifts or scaffolding shall be provided as required.

- C. Aiming of fixtures shall be done at night if the area receives significant amounts of daylight, such as atriums, or other areas enclosed primarily of glass.
- D. After final aiming is complete fixtures shall be locked in place to hold the fixture in the intended position.
- E. Advance notice shall be given to the architect prior to final aiming. The architect and/or engineer shall be present.

3.5 CLEANING AND PROTECTION

- A. Clean all fixtures internally and externally after installation. Use methods and materials as recommended by the manufacturer.
- B. Retain protective plastic on parabolic louvers until interior finishes are complete.
- C. Aluminum reflectors for linear fluorescent fixtures and downlights shall be installed such that oils and fingerprints do not etch the reflecting surface. Reflectors with damage caused by improper installation methods shall be replaced.

END OF SECTION 265100

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with lamps and ballasts.
 - 2. Luminaire-mounted photoelectric relays.
 - 3. Poles and accessories.
 - 4. Luminaire lowering devices.
- B. Related Sections include the following:
 - 1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

- A. CRI: Color-rendering index.
- B. HID: High-intensity discharge.
- C. Luminaire: Complete lighting fixture, including ballast housing if provided.
- D. Pole: Luminaire support structure, including tower used for large area illumination.
- E. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4.
- C. Ice Load: Load of 3 lbf/sq. ft. (143.6 Pa), applied as stated in AASHTO LTS-4.
- D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
 - 1. Wind speed for calculating wind load for poles exceeding 50 feet (15 m) in height is 70 mph (113 km/h).

1.5 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 2. Details of attaching luminaires and accessories.
 3. Details of installation and construction.
 4. Luminaire materials.
 5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
 - a. For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 - b. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 6. Ballasts, including energy-efficiency data.
 7. Lamps, including life, output, and energy-efficiency data.
 8. Materials, dimensions, and finishes of poles.
 9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 10. Anchor bolts for poles.
- B. Shop Drawings:
1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
 3. Wiring Diagrams: Power and control wiring.
- C. Samples for Verification: For products designated for sample submission in Exterior Lighting Device Schedule. Each sample shall include lamps and ballasts.
- D. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.
- E. Qualification Data: For agencies providing photometric data for lighting fixtures.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For luminaires, poles and luminaire lowering devices to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C2, "National Electrical Safety Code."
- D. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- D. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires, Poles, Metal Corrosion, Color Retention: Two years from date of Substantial Completion.
 - 2. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 5 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Lighting fixtures shall be provided from the manufacturers listed in the Lighting Fixture Schedule.
- B. Where more than one manufacturer is listed the first manufacturer is the basis of design. Alternate manufacturers are listed as potential sources of product equal to the basis of design. Listing of alternate manufacturers does not guarantee that an equal product is available as a standard product offering. A custom or modified version of a standard product, provided by one of the alternate manufacturers and a level of quality established by the standard series shown, will be reviewed for approval. Product will be accepted if technical specifications as well as aesthetic qualities meet or exceed those of the specified manufacturer. The architect reserves the right to reject or modify the proposed fixture from the alternate manufacturer as needed to match the specifications of the fixture chosen as the basis of design. Alternate manufacturers must have experience producing lighting fixtures similar to those specified for a minimum of 5 years.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field. Provide where indicated in schedule.
- J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

- K. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

- L. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of [manufacturer's standard] [custom] color.
 - c. Color: As selected by Architect from manufacturer's complete list of standard and optional available colors.

2.3 FLUORESCENT BALLASTS AND LAMPS

- A. Low-Temperature Ballast Capability: Rated by its manufacturer for reliable starting and operation of indicated lamp(s) at temperatures minus 20 deg F (minus 29 deg C) and higher.

- B. Ballast Characteristics:
 - 1. Power Factor: 90 percent, minimum.
 - 2. Sound Rating: A.
 - 3. Total Harmonic Distortion Rating: Less than 20 percent.
 - 4. Pulse Start Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
 - 5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
 - 6. Transient-Voltage Protection: Comply with IEEE C62.41 Category A or better.

- C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures minus 20 deg F (minus 29 deg C) and higher.

- D. Manufacturers:
 - 1. Advance.

- E. Fluorescent Lamps: Low-mercury type. Comply with the EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

- F. Manufacturers:
 - 1. Phillips
 - 2. General Electric

2.4 BALLASTS FOR HID LAMPS

- A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features, unless otherwise indicated:
 - 1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 - 2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).
 - 3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
 - 4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
- B. Approved manufacturer: Advance.

2.5 HID LAMPS

- A. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 4000 K.
- B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.
- C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.
- D. Manufacturers:
 - 1. Phillips
 - 2. General Electric

2.6 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
 - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
 - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
 - 3. Anchor-Bolt Template: Plywood or steel.
- D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

- E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.
- F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.7 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.
- B. Poles: ASTM B 209 (ASTM B 209M), 5052-H34 marine sheet alloy with access handhole in pole wall.
 - 1. Shape: as indicated on fixture schedule.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
 - 1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
 - 2. Finish: match luminaire.
- F. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - 3. Color to match luminaire or as selected by architect from manufacturers complete list of standard and optional available colors.

2.8 REQUIREMENTS FOR INDIVIDUAL EXTERIOR LIGHTING DEVICES

- A. See lighting fixture schedule included as part of contract drawings for requirements for individual fixtures.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming.

3.2 POLE INSTALLATION

- A. Align pole foundations and poles as directed by the architect in the field.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: 60 inches (1520 mm).
 - 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet (3 m).
 - 3. Trees: 15 feet (5 m).
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 3. Install base covers, unless otherwise indicated.
 - 4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch (25 mm) below top of concrete slab.
- F. Raise and set poles using web fabric slings (not chain or cable).

3.3 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top 4 inches (100 mm) or as indicated above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole, unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor and conductor protector.
 - 3. Ground metallic components of pole accessories and foundations.

3.6 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
 - a. IESNA LM-72, "Directional Positioning of Photometric Data."
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 265600

SECTION 270000 - GENERAL COMMUNICATIONS PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Scope of Work.
 - 2. Intent of Drawings.
 - 3. Pre-Bid Site Visit.
 - 4. Definitions.
 - 5. General Standards of Materials.
 - 6. Products and Substitutions.
 - 7. Applicable Codes.
 - 8. Guarantees and Certificates.
 - 9. Quiet Operation and Vibration Control.
 - 10. Temporary Shutdown of Existing Systems.
 - 11. Coordination.
 - 12. Shop Drawings, Product Data, and Samples.
 - 13. Owner Instruction.

1.3 SCOPE OF WORK

- A. The scope of the work included under Division 27 of the specifications shall include complete systems as shown in the Contract Documents and specified herein. Any work reasonably inferable or required to result in a complete installation or the intended operation and performance of the systems, shall be included in the Base Bid except where there is specific reference to exclusion and incorporation in other quotations.

1.4 INTENT OF DRAWINGS

- A. Provide complete and functional systems for the project. The systems shall conform to the details stated in the specifications and shown on the drawings. Items or work not shown or specified, but required for complete systems, shall be provided and conform with accepted trade practices. The drawings and specifications are presented to define specific system requirements and serve to expand on the primary contract requirements of providing complete systems. The drawings are diagrammatic and indicate the general arrangement and routing of the systems included in this contractors work.
- B. Do not scale the drawings. Because of the scale of the drawings, it is not possible to indicate offsets, fittings, valves, or similar items which may be required to provide complete operating systems. Carefully investigate conditions affecting the work associated with this project. Install systems in such a manner that interferences between pipes, conduit, ducts, equipment, architectural and structural features are avoided. Provide items required to meet the project conditions without additional cost to the owner.

- C. These documents may not explicitly disclose final details required for a complete systems installation; however, contractors shall possess the expertise to include the necessary appointments of complete operating systems.
- D. Contractors shall be experienced in this type of construction and realize the extent of the work required.
- E. Contractor shall coordinate equipment and installation with the Montgomery College IT Cable Standards and Audiovisual Standards.

1.5 DEFINITIONS

- A. Specific terminology, as used herein, shall have the following meanings:
 - 1. "Finished Space" ...Space other than mechanical rooms, electrical rooms, furred spaces, pipe chases, unheated spaces immediately below roof, space above ceilings, unexcavated spaces, crawl spaces, tunnels, and interstitial spaces.
 - 2. "Conditioned"...Spaces directly provided with heating and cooling.
 - 3. "Unconditioned"...Spaces without heating or cooling including ceiling plenums.
 - 4. "Indoors"...Located inside the exterior walls and roof of the building.
 - 5. "Outdoors"...Located outside the exterior walls and roof of the building.

1.6 REFERENCES

- A. Montgomery College Office of Information Technology's Voice/Data/Video Cabling Standards, ~~XXX~~
- B. Montgomery College Office of Information Technology's ITV Standards, ~~XXX~~
- C. Montgomery College Office of Information Technology's Audiovisual Standards, ~~XXX~~
- D. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
- E. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling
- F. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components
- G. ANSI/TIA-568-C.3, Optical Fiber Cabling Components
- H. ANSI/TIA-568-C.4, Broadband Coaxial Cabling and Components
- I. ANSI/TIA-569-C, Telecommunications Pathways and Spaces
- J. ANSI/TIA-606-B, Administration Standard Telecommunications Infrastructure
- K. ANSI/TIA-607-B, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- L. ANSI/TIA-758-A, Customer-Owned Outside Plant Telecommunications Cabling Standard
- M. ANSI/TIA-862-A, Building Automation Cabling Standard
- N. ANSI/TIA-942-A, Telecommunications Infrastructure Standard for Data Centers

- O. BICSI, Telecommunications Distribution Methods Manual, Latest Edition
- P. BICSI, Customer-Owned Outside Plant Design Manual, Latest Edition
- Q. BICSI, Wireless Design Reference Manual, Latest Edition
- R. National Fire Protection Association (NFPA)
- S. NFPA 70, National Electrical Code (NEC)
- T. Federal Communications Commission (FCC)
- U. Americans with Disabilities Act (ADA)
- V. Insulated Cable Engineers Associations, Inc. (ICEA)
- W. Society of Cable Telecommunications Engineers (SCTE)
- X. International Communications Industries Association (ICIA), Audiovisual Best Practices
- Y. All applicable local codes

1.7 GENERAL STANDARDS OF MATERIALS

- A. Equipment and materials, unless otherwise noted, shall be new and of first quality, produced by manufacturers who have been regularly engaged in the manufacture of these products for a period of not less than five years.
- B. Equipment of one type shall be the products of one manufacturer; similar items of the same classification shall be identical, including equipment, assemblies, parts and components.
- C. Materials furnished shall be determined safe by a nationally recognized testing organization, such as Underwriters' Laboratories, Inc., or Factory Mutual Engineering Corporation, and materials shall be labeled, certified or listed by such organizations. Where third party certification is required for packaged equipment, the equipment shall bear the appropriate certification label.
- D. With respect to custom made equipment or related installations which are constructed specially for this project, the manufacturer shall certify the safety of same on the basis of test data. The Owner shall be furnished copies of such certificates.
- E. Material shall be in compliance with Montgomery College IT Cable Standards and Audiovisual Standards.

1.8 PRODUCTS AND SUBSTITUTIONS

- A. Where several manufacturer's products are specified, the Contract Amount shall be based upon the specified products only. Any substitutions from the specified products shall be offered as a Substitution Request. Refer to Division 01 for requirements. Substitutions shall not be permitted after the bidding phase without a Substitution Request Form included with the bid.
- B. Where only one manufacturer's product is specified, the associated systems have been designed on the basis of that product. Where several manufacturer's products are specified, the associated systems have been designed on the basis of the first-named manufacturer's product. When products other than those used as the basis of design are provided, the

contractor shall pay additional costs related to submissions review, redesign, and system and/or structure modifications required by the use of that product.

- C. It is the intent of these specifications that service organizations follow the above substitution procedures.

1.9 APPLICABLE CODES

- A. Materials furnished and work installed shall comply with applicable codes listed in Division 01, with the requirements of the local utility companies, and with the requirements of governmental departments or authorities having jurisdiction.

1.10 COORDINATION

- A. Coordinate and furnish in writing to the Architect information necessary to permit the work to be installed satisfactorily and with the least possible interference or delay.
- B. When work is installed without proper coordination, changes to this work deemed necessary by the Architect shall be made to correct the conditions without extra cost to the Owner.

1.11 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. Shop drawings, product data, and samples shall be submitted in accordance with the provisions of Division 01.

1.12 OWNER INSTRUCTION

- A. After final tests and adjustments have been completed, furnish the services of qualified personnel to instruct representatives of the Owner in the operation and maintenance procedures for equipment and systems installed as part of this project. Operation and maintenance instructions for major items of equipment shall be directly supervised by the equipment manufacturer's representative. Supply qualified personnel to operate equipment for sufficient length of time as required to meet governing authorities' operation and performance tests and as required to assure that the Owner's representatives are properly qualified to take over operation and maintenance procedures.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 270000

SECTION 270500 - COMMON WORK FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Common communications installation requirements.
 - 3. Excavating and backfilling.
 - 4. Demolition
 - 5. Waterproofing.
 - 6. Weatherproofing locations.
 - 7. Cutting and Patching.
 - 8. Painting.
 - 9. Equipment Foundations, Supports, Piers and Attachments.
 - 10. Equipment Guards and Rails.
 - 11. Cleaning, Protecting and Adjusting.
 - 12. Welding.
 - 13. Sleeves for raceways and cables.
 - 14. Sleeve seals.
 - 15. Grout.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.
- C. Wiring: Cable and/or wire installed in Raceway.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 DEMOLITION

- A. Review the construction documents, to determine the affected areas of the existing structure. Remove communications appurtenances in the affected areas not to be reused including wire, conduit, switches, outlets, and fittings.
- B. Schedule and coordinate demolition with the Owner.

- C. Any conduit or wiring that is not to be permanently removed or that feeds other remaining sections of the building shall be relocated as necessary and rerouted and reconnected as required.
- D. Items removed above shall become the property of the Owner unless otherwise noted. If the Owner has no use for any of the items, remove them from the site.
- E. Maintain the continuity of any present communications circuits that may be interrupted by these alterations even though they may not be indicated on the drawings. Furnish the labor and necessary materials required to restore the communications circuit.
- F. Where communications circuits are looped and outlets are removed, make adjustments and connections to restore the circuits.
- G. Where existing communications devices and items are to be removed, ceilings, floors, wall partitions, etc., are to be patched by the Communications Contractor. Particular attention must be paid to associated construction types and methods of affected areas. All patching for these areas is to match the existing and intended finishes for that area no matter what the type of construction. Coordinate all patching work fully with the Architect and General Contractor.

1.6 WATERPROOFING

- A. Where work pierces waterproofing, including waterproof concrete, the method of installation shall be approved by the Architect prior to performing the work. Furnish necessary sleeves, caulking and flashing required to make openings absolutely watertight.

1.7 WEATHERPROOFING LOCATIONS (WP)

- A. Communication apparatus, such as outlet boxes, switches, connection panels, speakers, cameras, and other devices shall be weatherproof gasketed type, NEMA Types 3 or 4 in the following instances:
 - 1. On surface of exterior face of building, including areas where not under canopies, cast boxes with threaded hubs must be used and under canopies steel boxes with gasket connections to devices.
 - 2. In any areas where specifically noted "WP" or required by the NEC or Regulations mentioned herein.
 - 3. Within air conditioning enclosures.
 - 4. In underground splice boxes.
 - 5. On building roof.
 - 6. In unconditioned spaces subject to exterior ambient conditions.

1.8 CUTTING AND PATCHING

- A. Provide cutting and patching necessary to install the work specified herein. Patching shall match adjacent surfaces.
- B. No structural members shall be cut without prior approval of the Architect; such cutting shall be done in a manner directed by him.
- C. Provide ceiling removal and replacement where work above ceilings is required. Replace ceiling components damaged in the process.

- D. Provide patching where communications devices are removed from walls, ceilings or floors.

1.9 ACCESSIBILITY

- A. Coordinate to ensure the sufficiency of the size of shafts, and chases, and the adequacy of clearances in hung ceilings and other areas required for the proper installation of this work.
- B. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Locations in ceilings requiring access shall be coordinated with, but not limited to lights, curtain tracks, and speakers. Equipment requiring access shall include, but is not necessarily limited to, motors, junction boxes, fire dampers, controllers, switchgear, etc.
- C. Indicate the locations of access doors for each concealed device, concealed behind finished construction and requiring service on the coordination drawings. Equipment below floor slab or finished grade shall also be indicated on the coordination drawings.

1.10 PAINTING

- A. Provide surface preparation, priming, and final coat application in strict accordance with manufacturer's recommendations.
- B. Provide prime coat painting for the following:
 - 1. Indoor miscellaneous steel and iron provided under this Division of the specifications.
 - 2. Indoor hangers and supports provided under this Division of the specifications.

1.11 EQUIPMENT FOUNDATIONS, SUPPORTS, PIERS AND ATTACHMENTS

- A. Provide necessary foundations, auxiliary steel, supports, pads, bases and piers required for equipment specified in this division; submit drawings in accordance with Shop Drawing Submittal requirements prior to the purchase, fabrication or construction of same.
- B. Construction of foundations, supports, and pads where mounted on the floor, shall be of the same materials and same quality of finish as the adjacent and surrounding floor material.
- C. Equipment shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Architect, not strong enough shall be replaced as directed, with no additional cost to the Owner.

1.12 CLEANING, PROTECTING AND ADJUSTING

- A. Cleaning
 - 1. General cleaning requirements are specified in Division 01.
 - 2. Upon completion of the work, clean the exterior surface of equipment, accessories, and trim installed. Clean, polish, and leave equipment, accessories, and trim in first-class condition.

B. Protection of Surfaces

1. Protect new and existing surfaces from damage during the construction period.
2. Provide plywood or similar material under equipment or materials stored on floors or roofs. Provide protection in areas where construction may damage surfaces.
3. Surfaces damaged during the construction shall be repaired or replaced at the cost of the Contractor at fault. The method of repairing or replacing the surface shall be approved by the Owner and Architect.

C. Protection of Services

1. Protect new and existing services from damage during the construction period.
2. Repair, replace, and maintain in service any new or existing utilities, facilities, or services (underground, overground, interior, or exterior) damaged, broken, or otherwise rendered inoperative during the course of construction.
3. Services damaged during the construction shall be replaced at the cost of the Contractor at fault. The method used in repairing, replacing, or maintain the services shall be approved by the Owner and Architect.

D. Protection of Equipment and Materials

1. Equipment and materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.
2. Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and replacement if, in the opinion of the Architect or the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use or performance is questionable, or that its normal life expectancy has been curtailed.
3. During the construction period, protect equipment from damage and dirt.

1.13 SPECIAL TOOLS

- A. Provide the Owner's representative with two (2) sets of special tools required for operation and maintenance of equipment provided.

1.14 WELDING

A. General Requirements

1. This paragraph covers the welding of systems. Materials or components with welds made off the site shall not be accepted if the welding does not conform to the requirements of this specification. Develop and qualify procedures for welding metals included in the work. Certification testing shall be performed by an approved independent testing laboratory. Bear costs of such testing.
2. Certified welders, previously certified by test, may be accepted for the work without re-certification provided that all of the following conditions are fulfilled:
 - a. Submit copies of welder certification test records in accordance with this Division and Division 01 requirements.
 - b. Testing was performed by an independent testing laboratory.

- c. The welding procedures and welders are certified in accordance with the "ASME Boiler and Pressure Vessel Code," and base materials, filler materials, electrodes, equipment, and processes conform to the applicable requirements of this specification.
 - d. Certification has been within a one (1) year period from the start of the project.
3. Filler metals, electrodes, fluxes and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to assure safe handling.
 4. Submit welding certificates for review. Each welder assigned to work covered by this specification shall be certified by performance tests using equipment, positions, procedures, base metals, and electrodes or bare filler wires.
 5. Before assigning welders to the work, provide the architect with their names, together with certification that each individual is certified as specified. No welding work shall start prior to submissions. The certification shall state the type of welding and positions for which each is certified, the code and procedure under which each is certified, date certified, and the firm and individual certifying the certified tests.
 6. Each welder shall be assigned an identifying number, letter, or symbol that shall be used to identify his welds. A list of the welders' names and symbol for each shall be submitted. To identify welds, either written records indicating the location of welds made by each welder shall be submitted, or each welder shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 3 foot intervals. Identification by die stamps or electric etchers shall be confined to the weld reinforcing crown, preferably in the finished crater.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Coordinate piping systems installed at a required slope.
- F. Apply for detailed and specific information regarding the location of equipment as the final location may differ from that indicated on the drawings. Outlets, equipment or wiring improperly placed because of failure to obtain this information shall be relocated and re-installed without additional expense to the Owner. Determine the actual direction of door swings, so that local switches and other controls shall be installed at the lockside of doors, unless otherwise noted. Improperly located switches shall be relocated without additional expense to the Owner.

- G. The design shall be subject to such revisions as may be necessary to overcome building obstructions. No changes shall be made in location of outlets or equipment without written consent of the Architect and Owner.
- H. Unless otherwise mentioned or indicated, mounting heights of outlets are shown on the drawings or in the specification. Dimensions given shall be considered to be from center of outlet to finished floor.
- I. Coordinate the location and elevation of all communications devices and fixtures with the architectural interior elevation plan and reflective ceiling plan prior to installation.
- J. Properly rough in for the communications raceways and equipment under this contract and modify as required for coordination during the construction period.
- K. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- L. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed.
- M. Coordinate sleeve selection and application with selection and application of firestopping.

3.2 WELDING

- A. Perform welding in accordance with qualified procedures using certified welders. Welding shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions. Welding of hangers, supports, and plates to structural members shall conform to AWS specifications.
- B. Field bevels and shop bevels shall be by mechanical means or by flame cutting. Where beveling is by flame cutting, thoroughly clean surfaces of scale and oxidation just prior to welding. Beveling shall conform to ANSI B31.1 and AWS B3.0.
- C. Replace and reinspect defective welds. Repairing defective welds by adding weld material over the defect or by peening shall not be permitted. Welders responsible for defective welds must be re-certified.
- D. Store electrodes in a dry heated area, keep free of moisture and dampness during fabrication operations. Discard electrodes that have lost part of their coating.

3.3 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when raceways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, fire-rated floor, or wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

- E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
- J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.4 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly.

3.6 DUST, DIRT AND NOISE

- A. Carry out new work and make changes, relocations, and installations with a minimum of noise. Site areas and new equipment, floors and walls, shall be adequately protected from dust and dirt caused by the work. Protection shall include suitable temporary barriers or coverings. The exterior and interior premises of each building shall be kept clean as possible during construction. Damages to surfaces or equipment as a result of negligence shall be replaced or corrected as required.

- B. College activities will be under way during much of the construction period. It is imperative that College functions and activities are given priority and the highest level of respect. Contractor functions which may be excessively noisy or disruptive shall be scheduled for times when school functions will not be interrupted or disturbed.

3.7 ENVIRONMENTAL AIR PLENUMS

- A. In spaces over hung ceiling which are used for environmental air handling purposes as defined by Article 300.22C of the National Electric Code, power data and communications cable must be in conduit or of the type cable rated for air plenum use. Cable type and/or raceway is generally indicated on the drawings and specifications although the Contractor shall be responsible to clearly define ceiling space used for environmental air purposes.

END OF SECTION 270500

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 DEFINITIONS

- A. TMGB: Telecommunications Main Grounding Busbar
- B. TGB: Telecommunications Grounding Busbar
- C. TBB: Telecommunications Bonding Backbone
- D. TBBIBC: Telecommunications Bonding Backbone Interconnecting Bonding Conductor

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells
 - 2. Ground rods
 - 3. Ground rings
 - 4. Ground arrangements and connections for separately derived systems
 - 5. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS, ANSI/IEEE 81, and ANSI/IEEE 142.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.
- D. Comply with ANSI J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications and BICSI Telecommunications Distribution Methods Manual, latest edition for grounding and bonding installation and methods.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
- C. Conductors shall be soft drawn copper having conductivity not less than 98 percent.
- D. No aluminum conductors or lugs or splicing devices shall be permitted.
- E. The contractor shall provide insulated conductors with plenum rated insulation or bare copper conductors according to the NEC, UL 910, and UL 1820 where conductors are installed above finished ceilings or in environmental air plenums and acceptable to the authority having jurisdiction.
- F. All grounding conductors provided as part of the grounding for communications systems shall have green-colored insulation with continuous yellow stripe. Alternatively, where the approved manufacturer does not offer green insulation, provide bare copper wire with green tape for easy identification.
- G. Bare copper conductors shall not be provided as part of the grounding for communications systems unless approved prior to installation by the Engineer or required by code.

2.2 CONNECTORS AND COMPRESSION LUGS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Compression Lugs: Comply with BICSI Telecommunications Distribution Methods Manual (TDMM) and ANSI J-STD-607-A.

2.3 TELECOMMUNICATIONS GROUNDING BUSBARS

- A. Provide UL listed TMGB and TGB's as required per BICSI TDMM and ANSI J-STD-607-A.
- B. Provide busbar type 40153-012.
- C. Ground cable shall be 6 AWG as a minimum.
- D. Standards and Safety Codes: Conform to the following:
 - 1. UL 467 – Grounding and Bonding Equipment
 - 2. NFPA 70, NEC
 - 3. ANSI J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
 - 4. ANSI/IEEE Standard 1100
 - 5. ANSI T1.313

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Provide stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Bonding conductors provided from the TGB or TMGB to the telecom room components shall have a minimum size of No. 6 AWG.
- C. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
- D. Provide a telecommunications grounding and bonding system in accordance with the ANSI J-STD-607-A standard and Article 250 of the National Electrical Code and as described in the contract documents.
- E. All communications and electronic safety and security equipment, equipment racks, cabinets, boxes, conduit, and metal raceways shall be grounded in accordance with the NEC and as shown on the drawings and specified herein.
- F. All connections to apparatus and conduits shall be made with an approved type of solderless connector. Connectors shall be securely bolted or clamped to the equipment. All contact

surfaces shall be thoroughly cleaned and bright before connections are made in order to ensure a good metal-to-metal contact.

- G. Tie all grounding systems together at their origins as shown on the Drawings and as called for by the NEC.
- H. Provide an insulated ground wire sized as shown, bonding the TMGB and the electric service grounding electrode.
- I. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Connections to Structural Steel: Welded connectors where welding or exothermic welds are permitted within the building by project. Otherwise provide bolted or clamped connectors.

3.2 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- C. When terminal lugs are required on grounding conductors, install using positive compression type tool utilizing proper size fittings to accommodate lugs, for permanent tight connections. Box lugs and set screw lugs are not permitted.
- D. Do not run ground wires in Ferrous metal conduit longer than 3 feet. If metal conduit use cannot be avoided, ground both ends of the conduit to the ground conductor.
- E. Do not splice grounding conductors.
- F. Bond the telecommunications ground buses if shown on drawings to the building steel using bonding connector listed for the purpose. Horizontal steel members may be used to bond to if they are welded to columns.
- G. Ground wires required by the National Electrical Code shall be provided.
- H. The metallic shield of all entrance cables, backbone cables, cable trays, racks, panels, and protectors shall be bonded to the TMGB with minimum #6 AWG green insulated wire.
- I. Install all grounding conductors with sufficient slack to avoid breakage due to settlement or movement of conductors to attached points.
- J. Do not make short 90 degree turns in any grounding conductor. Use a radius for making turns.

- K. Ground all cable entrance protectors, primary protectors, and metallic cable sheaths used for communications outside plant cabling as close as practical to cabling point of entrance and route ground conductor to TMGB or closer approved ground.
- L. Where required by code, provide bare copper grounding conductors in environmental air plenums or provide grounding conductors with plenum rated insulation with approval from the engineer. Where bare copper grounding conductors are used, provide green colored tape for identification at all connection points.

3.3 IDENTIFICATION

- A. Provide cable label for all grounding conductors at connection points to busbars indicating the destination location of the grounding conductor.
- B. Provide nameplate mounted above each busbar indicating the busbar is a TMGB or TGB.
- C. Provide warning cable label per the requirements of ANSI J-STD-607A for each grounding and bonding conductor. Conductor shall be labeled as close as practical to its point of termination in a readable position. Warning label shall read: "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
 - 1. Perform testing as recommended by InterNational Electrical Testing Association, IEEE 81, IEEE 142, and IEEE 1100.
 - 2. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance along with testing agency test reports.

- C. Perform point-to-point tests to determine the resistance between the main grounding system and all telecommunications grounding busbars. Investigate point-to-point resistance values which exceed 0.5 ohm.

END OF SECTION 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a system of raceways for the Division 27 Communications Systems including but not limited to the following:
 - 1. Conduit
 - 2. Junction boxes
 - 3. Pull boxes
 - 4. Floor boxes
 - 5. Outlet boxes
 - 6. Cable trays
 - 7. Conduit sleeves
 - 8. Open top support systems
 - 9. Surface raceways
 - 10. Plywood backboards and cabling supporting rings
 - 11. Miscellaneous device backboxes
 - 12. Poke-thru devices
 - 13. Pull strings
- B. Provide raceways as required for the following low voltage systems:
 - 1. Data/Voice/Video Premise Wiring System
 - 2. Audiovisual Cabling Systems as identified on the drawings
- C. All raceways for voice/video/data systems shall adhere to ANSI/TIA/EIA 569 and recommendations of BICSI Telecommunications Distribution Methods Manual, latest edition.
- D. See additional requirements in specification section 260533.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Refer to related Division 27 sections for additional requirements.

2.2 PLYWOOD BACKBOARD

- A. Construction: Urea-formaldehyde free, FSC certified, void free, 3/4" (19 mm) x 4' (1.2 m) x 8' (2.4 m) A-C grade, fire retardant plywood.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Ground conduit to cable tray to ensure ground continuity.

- B. Raceway to data/voice/video outlets shall conform to TIA/EIA 569 conduit fill requirements unless otherwise stated. Refer to drawings for conduit configuration details.
- C. Provide EMT conduit from the data/voice/video outlet locations to cable trays or open top cable supports in all locations, unless otherwise stated. Where conduit to cable tray is not to be provided, provide approved open top cable supports.
- D. Each and every raceway shall be left with a nylon measuring fish line (200 pound test) tagged at each end.
- E. Coordinate exact location of backboxes with Architectural drawings prior to installation of raceways and backboxes and before construction of walls and floors.
- F. All recessed wall outlet backboxes shall be double ganged, 4" x 4" x 2 1/8" minimum size. Provide trim ring on outlet box as required for specific wall construction and size of faceplate.
- G. Do not install any Division 27 raceway or conduit below slab on grade unless shown or stated otherwise or approved by the Engineer.
- H. Each telecommunication system wall outlet shall have a dedicated outlet box and not be ganged together with power receptacles unless otherwise stated.
- I. Do not "daisy-chain" conduit between outlet back boxes for data/voice/video systems unless otherwise stated in specific cases.
- J. Provide metal sleeves through floors and walls for routing communications cabling. Where size of sleeves are not indicated, size to 40% maximum fill capacity.
- K. Provide raceways for audiovisual systems as shown on drawings.
- L. Expansion-Joint Fittings (Metallic conduit): Provide expansion fittings on every raceway larger than 1-1/2 inches, and use a 24 inch piece of LFMC on all conduit 1-1/2 inches and smaller where it crosses any building expansion joints. Verify exact location of building expansion joints prior to installation of raceway.
- M. Raceways Embedded in Slabs:
 - 1. Conduits shall not be installed in floor slabs, above grade, except where necessary to serve a floor box. Conduits to floor box shall be installed parallel with the corrugations of floor deck. Maximum conduit size shall not exceed 1 1/4 inch.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- N. Expansion-Joint Fittings (RNC): Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).
 - 1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - 2. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

3. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 4. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 5. Attics: 135 deg F (75 deg C) temperature change.
 6. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
 7. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- O. Plywood backboard installation requirements:
1. Mount on vertically on walls of Telecommunications Rooms, Security Rooms and other locations as indicated in the documents from 6" AFF to 8'-6" AFF (.152m-2.6m).
 2. Mount "C" grade surface facing wall.
 3. Provide a minimum of five (5) equally spaced fasteners along each vertical edge and down the centerline of each sheet of plywood.
 4. Fasteners shall be of the appropriate type for each substrate. Provide blocking or additional studs in framed walls to receive plywood backup panel fasteners. Securely anchor to wall:
 - a. In new hollow wall construction, solid blocking shall be installed and the plywood shall be fastened to the solid blocking with steel screws.
 - b. In existing hollow wall construction, toggle bolts shall be used to fasten the plywood to the wall.
 - c. In concrete walls, steel expansion anchors shall be used to fasten the plywood to the wall. The use of tap-con fasteners are not acceptable.
- P. Underground conduit shall be 5" minimum, installed water tight and free of obstructions.
- Q. A minimum of two (2) 5" conduit shall route between buildings.
- R. Conduit stubbing into MDF/IDF shall extend as a minimum of 4 inches above the finished floor.
- S. Conduit shall terminate with insulated bushings or "No Nik" guards.
- T. Ladder rack shall be provided to route cabling extending from below floor level.
- U. Interior riser conduit shall be 4" and shall be firestopped per code.

END OF SECTION 270528

SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

- A. Provide a complete system of open top cable supports for Division 27 systems where required or permitted. Open top cabling supports may not be used where conduit or cable tray are required.
- B. Related Sections include the following:
 - 1. Division 27 section "Pathways for Communications Systems."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, accessories, attachment methodings, materials, approvals, load ratings, and dimensional information.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, mechanical connections, features, and material lists for each item specified.

1.4 COORDINATION

- A. Coordinate cable runs and final locations for installation of non-continuous cable support devices (J-Hooks) with all project contractors and trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Non-continuous Cable Supports (J-Hooks)
 - a. Erico Caddy
 - b. Cooper B-Line
 - c. Thomas & Betts
 - 2. Non-continuous cable supports and cable support assemblies shall be listed by Underwriters Laboratories for both Canadian and US standards (cULus).
 - 3. Non-continuous cable supports shall have the manufacturers name and part number stamped on the part for identification.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Non-continuous Cable Support (J-Hooks) Systems

1. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
2. Install cables using techniques, practices, and methods that are consistent with Category 5e/6 and fiber cabling and that supports Category 5e/6 and fiber cabling performance of completed and linked signal paths, end to end.
3. Install cables without damaging conductors, shield, or jacket.
4. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
5. Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.
6. Do not exceed load ratings specified by manufacturer.
7. Follow manufacturer's recommendations for allowable fill and load capacity for each size non-continuous cable support, allowing for 50% future spare capacity.
8. Non-continuous cable supports shall be provided in locations as required to route cabling in ceiling spaces where cable tray is not provided.
9. Pathways should route cabling over top of heating ducts and other conduit.

END OF SECTION 270529

SECTION 270534 FLOOR BOXES AND POKE THRU'S FOR ELECTRICAL AND COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 CLASSIFICATION AND USE

- A. This section includes floorboxes and poke-thrus for above-grade concrete floors and on-grade with a vapor barrier. These devices shall provide recessed/flush mounted device outlets that will not obstruct the floor area.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Wiremold RFB4 and Wiremold Evolution type poke thrus as indicated.

2.2 FLOORBOX RFB4

- A. The box shall be manufactured from cast-iron and approved for use on grade and above grade floors. The box shall be 14-1/2" L x 11-7/8" W x 3-7/16" H [368mm x 302mm x 87mm].
- B. Provide the box with four (4) independent wiring compartments that allow capacity for up to four (4) duplex receptacles and/or communication services. The box shall permit tunneling from adjacent or opposite compartments. Two (2) of the four (4) compartments shall have a minimum wiring capacity of 27 cu in [443cu cm], and two (2) compartments shall have a minimum wiring capacity of 36 cu in [590cu cm]. Four (4) compartments shall have a minimum of two (2) inches of space behind the device plates.
- C. The box shall include the following number of conduit hubs: four (4) 1-inch [25mm] and four (4) 1-1/4-inch [32mm].
- D. The box shall be fully adjustable, providing a maximum of 1-7/8-inch [48mm] pre-pour adjustment, and a maximum of 3/4-inch [19.1mm] after-pour adjustment. The box shall include a series of device mounting plates that will accept both duplex power devices as well as plates that will accommodate Ortronics® workstation connectivity outlets and modular adapters, Legrand AVIP audio/video device plates, and other open system devices

2.3 POKE THROUGH EVOLUTION TYPE 6AT (To be utilized at PT-1 locations)

- A. This assembly consists of an insert and an activation cover. Overall poke-thru assembly length shall be 16 3/4" [425mm]. The insert body shall recess the devices a minimum of 2 3/4" [69 mm] and have a polyester based backing enamel finished interior (ivory). There shall be the necessary channels to provide complete separation of power and communication services.
- B. There shall be three compartments that allow for up to three duplex receptacles that can be wired as a standard receptacle or isolated ground and/or twelve communication ports and/or ten of Extron® Electronics MAAP™ and/or two AAP™ devices.

- C. The body will consist of an intumescent fire stop material to maintain the fire rating of the floor slab. The intumescent material will be held securely in place in the insert body and shall not have to be adjusted to maintain fire rating of the unit and the floor slab. The insert shall have retaining feature that will hold the poke-thru device in the floor slab without additional fasteners.
- D. The poke-thru insert shall also consist of a 3/4" trade size conduit stub that is connected to the insert body and a 24.5 cu. in. [402ml] stamped steel junction box for wire splices and connections. The stamped steel junction box shall also contain the necessary means to electrically ground the poke-thru device to the system ground.
- E. The activation covers shall be manufactured of die-cast aluminum alloy and be available in powder-coated gray, black, or plated in brass, nickel or bronze finish. Two gaskets (one for carpet and one for tile) are provided to go under the trim flange to maintain scrub water tightness. The activation cover shall be 7 1/4" [184mm] in diameter. The activation covers shall be available in carpet and tile versions. The carpet covers shall be surface mounted and the tile covers shall be flush with the finished floor covering. The cover shall have spring loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.
- F. The activation shall have three locations to mount communication connectors. Connectors shall be mounted using a mounting bracket. Mounting brackets shall be provided to mount up to twelve Category 6 insert modules or six Category 6 discrete keystone connectors. The unit shall also accommodate a mechanism to permit protection of communication cabling. This mechanism shall be stamped steel construction and accept both flexible and rigid conduit. This mechanism shall accept 3/4", 1-1/4" or 2" trade size conduits.

2.4 POKE THROUGH EVOLUTION TYPE 8AT (To be utilized at PT-2 locations)

- A. This assembly consists of an insert and an activation cover. Overall poke-thru assembly length shall be 16 3/4" [425mm]. The insert body shall recess the devices a minimum of 2 3/4" [69 mm] and have a polyester based backing enamel finished interior (ivory). There shall be the necessary channels to provide complete separation of power and communication services. There shall be five compartments that allow for up to five duplex receptacles that can be wired as a standard receptacle or isolated ground and/or twenty-two communication ports and/or sixteen of Extron® Electronics MAAP™ and/or four AAP™ devices.
- B. The body will consist of an intumescent fire stop material to maintain the fire rating of the floor slab. The intumescent material will be held securely in place in the insert body and shall not have to be adjusted to maintain fire rating of the unit and the floor slab. The insert shall have retaining feature that will hold the poke-thru device in the floor slab without additional fasteners. The poke-thru insert shall also consist of a 3/4" trade size conduit stub that is connected to the insert body and a 24.5 cu. in. [402ml] stamped steel junction box for wire splices and connections. The stamped steel junction box shall also contain the necessary means to electrically ground the poke-thru device to the system ground.
- C. The activation covers shall be manufactured of die-cast aluminum alloy and be available in powder-coated gray, black, or plated in brass, nickel or bronze finish. Two gaskets (one for carpet and one for tile) are provided to go under of the trim flange to maintain scrub water tightness. The activation cover shall be 9 1/4" [235mm] in diameter. The activation covers shall be available in carpet and tile versions. The carpet covers shall be surface mounted and the tile covers shall be flush with the finished floor covering. The cover shall have spring loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.

- D. The activation shall have three locations to mount communication connectors. Connectors shall be mounted using a mounting bracket. Mounting brackets shall be provided to mount up to twelve Ortronics TracJack Category 6 insert modules or TechChoice™ Category 6 discrete keystone connectors. The unit will also be supplied with two Category 6 keystone connectors and two Lucent® keystones. The unit shall also accommodate a mechanism to permit protection of communication cabling. This mechanism shall be stamped steel construction and accept both flexible and rigid conduit. This mechanism shall accept 3/4", 1-1/4" or 2" trade size conduits.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide conduits to the device for various services as required.
- B. Field verify final location of all floor boxes.
- C. Provide lid activation covers of type, finish, and configuration as required. Final configuration shall be approved by the Architect.
- D. Provide additional supplemental support for the poke through as needed to securely set it at the proper elevation prior to pour.
- E. The contractor shall identify the final finished floor type prior to installation. Consult with the manufacturer for directions and elevations for installing the floor box and poke thru with that type of floor finish. Provide the complete installation as required for that finished floor type.
- F. Provide device brackets for mounting power and communications devices and jacks. Coordinate with the Architect for the final configurations and types required for each floor box or pokethru. The Contractor shall provide any configuration and type required.
- G. Provide lids (activation covers) for every device. Coordinate with the Architect for the final lid configuration and type required for each floor box. The contractor shall provide any configuration and type required.

END OF SECTION 270534

SECTION 270536 – CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Provide cable tray as shown on the drawings for distribution of horizontal premise wiring and/or vertical riser cabling. The Contractor may use cable tray in lieu of open top non-continuous cable supports in accessible areas.
- B. The cable tray specified in this section shall not be used for installation of electrical power, lighting, control system, or fire alarm system cabling under any circumstances even though it may be permitted by Code. Additionally, the only cabling permitted to be installed in this cable tray is for the following systems
 1. Voice, video and data premise network system comprising of Category 5e/6, optical fiber, and/or coaxial cabling.
 2. Security system cabling (access control, intrusion detection, and electronic surveillance)
 3. Audiovisual System cabling
- C. Provide necessary fittings, supports, grounding, and other hardware, which may be required to provide a complete installation. The complete systems shall be assembled from factory supplied parts.
- D. Entire installation shall comply with TIA/EIA 569 requirements for premise wiring.
- E. The cable tray system shall be capable of being installed on walls, ceilings, floors, and can be side supported or center hung.
- F. The cable tray type specified herein shall not be used in Telecommunications Rooms (IDF's) or MDF's.

PART 2 - PRODUCTS

2.1 TELECOMMUNICATIONS WIRE MESH CABLE TRAY

- A. Telecommunications wire mesh cable tray shall be 6", 18", or 24" wide wire basket tray, 4" deep as indicated on drawings (B-Line FT4X6X10, FT4X18X10, or FT4X24X10).
 1. Provide washer splice kit (B-Line Washer SPL KIT_).
 2. Provide 90 degree kit (B-Line 90 DEGREE KIT_).
 3. Cable tray supports may be by cantilever or trapeze brackets, individual rod suspension (both sides of tray, no center supports) and shall be placed on 5 ft centers as a minimum.
 4. Tray shall support a minimum of 60lbs/linear foot.
 5. Threaded rods supporting cable tray shall support 800lbs.
 6. Cable tray shall be a continuous, rigid, welded steel wire mesh cable tray.
 7. The wire mesh shall be welded at all intersections.
 8. Cable tray shall be UL listed.

9. Tray shall be constructed with carbon steel wire, ASTM-A-510. Wire shall be welded into a net, then formed into channels to carry cabling.
10. Field fabricate fittings from straight sections in accordance with the manufacturer's instructions.
11. Furnish all installation hardware as recommended and as manufactured by the cable tray manufacturer.
12. Cable tray and accessories shall have electroplated zinc galvanized coating, 0.7 to 0.8 mil in thickness.

PART 3 - EXECUTION

3.1 INSTALLATION OF TELECOMMUNICATIONS CABLE WIRE MESH TRAY

- A. Install cable trays using hardware, splice connectors, support components, joint ground bonding, and accessories available from the manufacturer.
- B. All field fabricated sections shall conform to manufacturer's recommendations.
- C. Provide minimum #6 AWG standard ground wire entire length of cable tray or ground per manufacturer's requirements to meet NEC and UL grounding criteria. Final grounding configuration shall be approved by the Engineer.
- D. Fully coordinate routing of tray with other building systems.
- E. Field verify routing of all cable trays. Provide any and all access panels required to access and install cabling onto tray. Access to cable trays shall not be continuously blocked for more than six meters or at turns in cable tray. All access panel locations shall be approved by the Engineer.
- F. Provide all penetrations and firestopping as required for routing cable tray through building.
- G. Provide cable tray support in accordance with manufacturer's span loading criteria and loading and fill recommendations. The tray shall support cabling per TIA/EIA 569 recommendations.
- H. All bending and transitions required in runs of cable tray shall be field fabricated by bending and cutting sections of wire mesh tray per manufacturer's requirements and recommendations.
- I. Long radiused bends shall be provided at each point of cable tray intersection or "tee" crossing.
- J. Maintain accessibility to tray above accessible ceilings.
- K. Provide 90 degree sweeps when cable tray changes direction.
- L. Cable tray shall be continuous with no breaks or sharp edges.
- M. Maintain minimum 4" clearance between category 6 cabling and power cabling. Provide clearance around cable tray in accordance with EIA/TIA 569.

END OF SECTION 270536

SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a cable plant labeling system that will allow the Owner to easily identify the origin and destination of each and every cable and outlet installed under this contract. The section includes minimum requirements for the following:
 - 1. Labeling communications cabling.
 - 2. Labeling communications hardware and equipment.
 - 3. Labeling work station outlets and faceplates.
 - 4. Labeling communications pathways.
 - 5. Labeling communications spaces.
 - 6. Labeling communications grounding and bonding components.
 - 7. Labeling of outlets on project record drawings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, and accessories.

1.4 QUALITY ASSURANCE

- A. Identification and administration work specified herein shall comply with the applicable requirements of:
 - 1. ANSI/TIA/EIA – 606-A Administration Standards.
 - 2. ANSI/TIA/EIA – 569 Pathway and Spaces
 - 3. ANSI/TIA/EIA – 568-A Telecommunications Cabling Standard.
 - 4. BICSI Telecommunications Distribution Methods Manual, latest edition
 - 5. UL 969.

PART 2 - PRODUCTS

2.1 CABLING LABELS

- A. Cable labels shall conform to the Labeling Standards of the Montgomery College IT cabling Standards.
- B. Cable labels shall be pressure sensitive labels with non-smearing printing.
- C. The labels shall be long lasting adhesive type.
- D. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
- E. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.

- F. Provide vinyl substrate with a white printing area and black print. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow, so that the labels are easily distinguishable.
- G. Shall be flexible vinyl or other substrates to apply easy and flex as cables are bent.
- H. Shall use aggressive adhesives that stay attached to all cable insulation types.
- I. Cabling labels shall be generated with laser printers.
- J. Physical dimensions of cabling labels provided shall correspond to type of cable. Provide label sizes for various cables as recommended by the manufacturer.

2.2 COMMUNICATIONS HARDWARE AND EQUIPMENT IDENTIFICATION LABELS

- A. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.
- C. Where insert type labels are used, provide clear plastic cover over label.

2.3 GROUNDING AND BONDING, PATHWAY, AND SPACE LABELS

- A. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.

2.4 WORKSTATION LABELS

- A. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.
- C. Where insert type labels are used, provide clear plastic cover over label.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate with Owner for approval of all labeling codes and schemes with Owner prior to creation and installation of labeling system.
- B. The final building room numbers selected by the Owner may vary from the room numbers indicated on the drawings.
- C. Labels shall include building code, room number, closet number, rack number and panel number.

3.2 CABLE LABELING

- A. Label each end of each cable with its identification number prior to pulling. Locate labels at a location which will not be mutilated or destroyed when cables are dressed for terminal installation.
- B. Horizontal and Backbone Cables shall be marked within 12 inches of each endpoint.

- C. Any cable installed in conduit shall be labeled at all intermediate pull or junction boxes.
- D. Label cables using the appropriate circuit ID.
- E. Use adhesive type labels for all communications cable labels.
- F. Affix labels to cables – marking cable is not permitted.
- G. Label both ends of each patch cord provided as part of the system.

3.3 LABELING OF PATCH PANELS

- A. This section describes the label that needs to be added to the patch panel locations including RJ-45 modular, fiber, and 110 blocks. This label is an abbreviated version of the label described in 3.2 above.
- B. Provide labeling for patch panels (including RJ-45 modular patch panels for voice, video, and data; optical fiber patch panels; and 110 blocks). Label each individual patch panel as well as each port or position on that patch panel.
- C. The Communications Contractor shall submit label strips for approval by the Engineer prior to construction.
- D. Patch Panels
 - 1. Fiber patch panels shall be marked using adhesive labels indicating the range of circuits installed to it.
 - 2. Category 5e/6 patch panels shall be labeled with an identifier, individual ports shall be labeled with an identifier.
- E. 110 Blocks
 - 1. Each cable termination position on 110 and BIX blocks shall be labeled with number designators.
 - 2. For 110 blocks where insert type labels are used, install clear plastic cover over preprinted or laser printed type label.

3.4 LABELING OF THE WORKSTATION OUTLETS

- A. This section describes the labeling scheme for the outlet plates in the rooms.
- B. On top of every faceplate, provide a label with full label identification as listed in 3.2 for the first jack in the faceplate.
- C. Provide jacks color coded as required.
- D. All faceplate labels shall indicate the circuit ID for each cable that it houses.
- E. For faceplates where insert type labels are used, install clear plastic cover over preprinted or laser printed type label.
- F. For faceplates without insert type labels, use adhesive type labels. Affix labels to faceplate; marking faceplates is not permitted.
- G. Workstation patch cords shall be labeled at each endpoint using the appropriate circuit ID.

- H. Use adhesive type labels for all communications cable labels.
- I. Affix labels to cables; marking cable is not permitted.

3.5 CABLE SCHEDULES

- A. All cable schedules are to be neatly typed.
- B. Provide one set of schedules covered by a shrink plastic process for each Telecom Room. Include all schedules which pertain to a specific closet in the set for that particular Telecom Room.
- C. Provide the Owner with one complete electronic set of all cabling schedules and patch panel identification schemes.
- D. Provide three blank forms for the Owner's future use.

3.6 LABELING OF PATHWAYS

- A. Pathways shall be marked at each endpoint, all intermediate pull or junction boxes, manholes or splice points. In the case of partitioned pathways each partition shall have a unique identifier.
- B. Label pathways using the appropriate abbreviation and a number.
- C. Use adhesive type labels.

3.7 LABELING OF EQUIPMENT RACKS, CABINETS, AND FRAMES

- A. On each equipment rack, distribution frame, and cabinet, provide a nameplate with white background and black lettering. The nameplate shall be minimum 1/2 inch high and have gothic style font. The nameplate shall be phenolic with engraved designation. Additionally, all rack mounted power strips and receptacles on racks, frames, or cabinets shall be labeled with panel name and circuit number.

3.8 LABELING OF OUTLETS ON PROJECT RECORD DRAWINGS

END OF SECTION 270553

SECTION 270800 - TESTING OF COMMUNICATIONS CABLING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section describes the requirements for the testing of the technology system cabling plants including Category 6 systems, UTP backbones, and optical fiber systems.
- B. Section includes:
 - 1. Category 6 cable plant testing and documentation.
 - 2. Fiber Optic System cabling plant testing and documentation.
 - 3. Copper UTP backbone cabling plant testing and documentation.
- C. Provide all labor, materials, tools, field-test instruments, and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.

1.3 DEFINITIONS

- A. OTDR: Optical Time Domain Reflectometer
- B. NEXT: Near End Cross-Talk
- C. ELFEXT: Equal Level Far End Cross Talk
- D. ACR: Attenuation to Cross-Talk Ratio
- E. UTP: Unshielded Twisted Pair

1.4 STANDARDS AND CODES

- A. ANSI/TIA/EIA 568-B.2-1 Category 6 and ISO Class E.
- B. ISO-IEC 11801 2nd Edition and EN 50173 Class C and D: Permanent Link Channel.
- C. ANSI/TIA/EIA 568B Category 5e and Category 6.
- D. TIA Level III accuracy.
- E. ANSI Z136.2 ANS for Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources.
- F. ANSI/EIA/TIA-455-50B, Light Launch Conditions for Long-Length Graded-Index Optical Fiber Spectral Attenuation Measurements.
- G. ANSI/TIA/EIA-455-59A, Measurement of Fiber Point Discontinuities Using an OTDR.

- H. ANSI/TIA/EIA-455-60A, Measurement of Fiber or Cable Length Using an OTDR.
 - I. ANSI/TIA/EIA-455-61A, Measurement of Fiber or Cable Attenuation Using an OTDR.
 - J. ANSI/TIA/EIA-526-7, Optical Power Loss Measurements of Installed Singlemode Fiber Cable Plant.
 - K. ANSI/TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
 - L. ANSI/TIA/EIA-568-B.1, Commercial Building Telecommunications Cabling Standard, Part 1, General Requirements.
 - M. ANSI/TIA/EIA-568-B-3, Optical Fiber Cabling Components Standard.
 - N. TIA/EIA TSB-140, Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
 - O. ANSI/TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure, including the requirements specified by the customer, unless the customer specifies their own labeling requirements.
- 1.5 SUBMITTALS
- A. Product Data: For copper and optical fiber cabling testing equipment and documentation reports. Include the following information:
 - 1. Complete data sheet and specifications for all cable testing equipment to be used by the Contractor.
 - 2. List of cable types the equipment is designed to test.
 - 3. List of test standards equipment will test to.
 - 4. List of testing parameters equipment will support.
 - 5. Letters from approved manufacturers of all components of the installed cabling plants to be tested and verified. The letter shall be an endorsement of the cable testing equipment for use with testing the specific products installed and approval for using cable testing equipment to verify performance and installation requirements for issuing product warranties. These letters shall be directly issued from the manufacturers on their letterhead to the approved cable testing equipment manufacturer.
 - B. Sample Test Reports: Provide a sample test report sheet for each type of cable test required to be performed. The sample test reports shall indicate the format and all test parameters that are required to be provided.
 - C. Equipment Calibration Certificates: Provide certificate indicating date and procedures used to calibrate all test equipment used. Provide verification that equipment has been calibrated according to manufacturer's recommendations.
 - D. Testing Procedures: Provide a description of cable testing procedures to be used for each type of cable test required. List applicable standards and methodologies to be implemented in the testing processes.
 - E. Pre-installation Test Reports: Submit pre-installation test reports of optical fiber on the reel performed at the project site prior to installation. In addition, submit manufacturer's factory test documentation for comparison.

1.6 QUALITY ASSURANCE

- A. Source Limitations: All cable tests of same type shall be performed by identical cable test equipment from the same manufacturer.
- B. Independent Verification: Cabling test equipment shall be verified to comply with the TIA/EIA-568-B.2-1 standard by an independent third party agency.
- C. Application Assurance Warranties: The entire cabling plant shall be warranted as required by the approved manufacturers. The specified warranties shall require full repair or replacement of defective material and labor that does not perform to project specifications.

1.7 PRE-INSTALLATION TESTING

- A. All fiber optic cables and all fibers in them should be tested on the reel at the project site before installation. The test results and the factory test documentation shall be submitted prior to installation. This testing shall be done as follows:
 - 1. Multi Mode Fibers: Use a fiber optic light source of 850 nm and 1300 nm and connect to one end of the fiber. Use a fiber optic receiver to check the loss at the other end. The results should then be compared with the fiber length listed on the reel. The test results shall be submitted to the Architect.
 - 2. Single Mode Fibers: Perform the tests listed for multimode fiber in paragraph 1.2.B.1 but the light wave length should be 1310 nm and 1550 nm.

1.8 COORDINATION

- A. Notify the Owner, Architect, and Construction Manager (if used for the project) a minimum of seven days prior to performing cable testing and provide a schedule indicating cables and locations that will be tested. The Owner or Architect may observe testing at their discretion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Category 6 Test Equipment

- 1. Manufacturers: Subject to compliance with requirements, provide required cable testing and documentation with cable testing equipment by one of the following:
 - a. Agilent Technologies Wire Scope 350
 - b. Fluke Networks DSP-4300 or DTX Cable Analyzer
 - c. JDSU LANTEK 6

B. Optical Fiber Cable Test Equipment

- 1. Manufacturers: Subject to compliance with requirements, provide required cable testing and documentation with cable testing equipment by one of the following:
 - a. Agilent Technologies
 - b. Fluke Networks
 - c. JDSU

2.2 OPTICAL FIBER CABLE TEST EQUIPMENT REQUIREMENTS

A. Optical loss test set (OLTS)

1. Multimode optical fiber light source
 - a. Provide dual LED light sources with central wavelengths of 850 nm (± 30 nm) and 1300 nm (± 20 nm)
 - b. Output power of -20 dBm minimum.
 - c. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-B.1) with a Category 1 light source.
2. Singlemode optical fiber light source
 - a. Provide dual laser light sources with central wavelengths of 1310 nm (± 20 nm) and 1550 nm (± 20 nm).
 - b. Output power of -10 dBm minimum.
3. Power Meter
 - a. Provide 850 nm, 1300/1310 nm, and 1550 nm wavelength test capability.
 - b. Power measurement uncertainty of ± 0.25 dB.
 - c. Store reference power measurement.
 - d. Save at least 100 results in internal memory.
 - e. PC interface (serial or USB).
4. Optional length measurement
 - a. Use an OLTS that is capable of measuring the optical length of the fiber using time-of-flight techniques.

B. Optical Time Domain Reflectometer (OTDR)

1. Internal non-volatile memory and removable memory device with at least 16 MB capacity for results storage.
2. Serial and USB ports to transfer data to a PC.
3. Multimode OTDR
 - a. Wavelengths of 850 nm (± 20 nm) and 1300 nm (± 20 nm).
 - b. Event deadzones of 1m maximum at 850 nm and 2 m maximum at 1300 nm.
 - c. Attenuation deadzones of 6 m maximum at 850 nm and 15 m maximum at 1300 nm.
 - d. Distance range not less than 2000 m.
 - e. Dynamic range at least 10 dB at 850 nm and 1300 nm.
4. Singlemode OTDR
 - a. Wavelengths of 1310 nm (± 20 nm) and 1550 nm (± 20 nm).
 - b. Event deadzones of 2 m maximum at 1310 nm and 2 m maximum at 1550 nm.
 - c. Attenuation deadzones of 15 m maximum at 1310 nm and 15 m maximum at 1550 nm.
 - d. Distance range not less than 10000 m.
 - e. Dynamic range at least 10 dB at 1310 nm and 1550 nm.

C. Fiber Microscope

1. Magnification of 250X or 400X for endface inspection.
2. Use test equipment capable of saving and reporting the endface image.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Category 6 Installation: Field test requirements upon completion of the installation.

1. General Requirements

- a. Every cabling link in the installation shall be tested in accordance with the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-B.1 (March 2001) Section 11.2: 100-Ohm twisted-pair transmission performance and field test requirements.
- b. One hundred percent of the installed cabling links must be tested and must pass the requirements of the standards mentioned above. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with project requirements.
- c. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include, but are not limited to, installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).
- d. The test equipment (tester) shall comply with or exceed the accuracy requirements for enhanced level III (Level III) field testers as defined in TIA-568-B; Annex 1: Section 1.4. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 1.4 of Annex 1 of TIA/EIA-568-B.2. (Table 1.5 in this TIA document specifies the accuracy requirements for the Channel configuration.)
- e. The tester shall be within the calibration period recommended by the vendor in order to achieve the required measurement accuracy.
- f. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, use a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
- g. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass.

2. Performance Test Parameters

The test parameters for Category 6 are defined in TIA Cat 6 standard, which refers to the ANSI/TIA/EIA-568-B.2 standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test, all measurements (at each frequency in the range from 1 MHz through 200 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

- a. Wire Map
- b. Length
- c. Insertion Loss (Attenuation)
- d. NEXT Loss
- e. PSNEXT Loss
- f. ELFEXT Loss, pair-to-pair
- g. PSELFEXT Loss
- h. Return Loss
- i. ACR
- j. PSACR
- k. Propagation Delay
- l. Delay Skew

B. Optical Fiber Installation: Field test requirements upon completion of the installation.

1. General Requirements

- a. Testing shall be carried out in accordance with this document. This includes testing the attenuation and polarity of the installed cable plant with an optical loss test set (OLTS) and the installed condition of the cabling system and its components with an optical time domain reflectometer (OTDR). The condition of the fiber endfaces shall also be verified.
- b. Testing shall be performed on each cabling link (connector to connector).
- c. The post-installation tests shall be bidirectional.
- d. Testing shall be performed on each cabling link installed.
 - 1) Testing shall not include any active devices or passive devices within the link other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
- e. All tests shall be documented including OLTS dual wavelength attenuation measurements for multimode and singlemode links, and OTDR traces and event tables for multimode and singlemode links.
- f. Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization.
 - 1) Manufacturer of the fiber optic cable and/or the fiber optic connectors.
 - 2) Manufacturer of the test equipment used for the field certification.
 - 3) Training organizations (e.g. BICSI, A Telecommunications Association headquarters in Tampa, Florida; ACP (Association of Cabling Professionals) Cabling Business Institute located in Dallas, Texas)
- g. All outlets, cables, patch panels and associated components shall be fully assembled, terminated, and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work.

2. Optical Fiber Cable Testing Parameters

- a. Field-test instruments shall have the latest version software and firmware installed.
- b. Link test results from the OLTS and OTDR shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.
- c. Fiber endfaces shall be inspected at 250X or 400 X magnifications. 250X magnification is suitable for inspecting multimode and singlemode fibers. 400X magnification may be used for detailed examination of singlemode fibers. Scratched, pitted or dirty connectors shall be diagnosed and corrected.
- d. Testing shall be performed on each cabling segment (connector to connector).
- e. Testing of the cabling shall be performed using high-quality test cords of the same fiber type as the cabling under test. The test cords for OLTS testing shall be between 1 m and 5 m in length. The test cords for OTDR testing shall be approximately 100 m for the launch cable and at least 25 m for the receive cable.
- f. Optical loss testing
 - 1) Backbone link
 - a) Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper or the equivalent method.
 - b) Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper or the equivalent method.
 - c) Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
 - d) Use the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1 or the equivalent method. The Contractor shall follow the procedures established by these standards or application notes to accurately conduct performance testing.
 - e) Each fiber link shall be tested in both directions.
 - g. OTDR Testing
 - 1) Backbone links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.
 - a) Backbone multimode: 850 nm and 1300 nm
 - b) Backbone singlemode: 1310 nm and 1550 nm
 - 2) Each fiber link shall be tested in both directions.
 - 3) A launch cable shall be installed between the OTDR and the first link connection.
 - 4) A receive cable shall be installed after the last link connection.
 - h. Magnified Endface Inspection
 - 1) Fibers shall be inspected at 250X or 400X magnification. 250X magnification is suitable for inspecting multimode and singlemode fibers.

400X magnification may be used for detailed examination of singlemode fibers.

i. Length Measurement

- 1) The length of each fiber shall be recorded.
- 2) It is preferable that the optical length be measured using an OLTS or OTDR.

j. Polarity Testing

- 1) Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with subclause 10.3 of ANSI/TIA/EIA-568-B.1. The polarity of the paired duplex fibers shall be verified using an OLTS.

3.2 TEST RESULT DOCUMENTATION

A. Category 6 Test Result Documentation

1. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test.
2. The test results recorded saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection and archiving of these test records. The measurement results must be transferred to the PC unaltered, i.e. "as saved in the tester" at the end of each test and that these results cannot be modified at a later time.
3. The database for the completed job shall be stored and delivered on CD-ROM including the software tools required to view, inspect, and print any selection of test reports. Provide two (2) CD-ROM sets with all required test results to the Architect and Owner for approval.
4. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
 - a. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number.
 - c. The date and time the test results were saved in the memory of the tester.
5. General information to be provided in the electronic data base with the test results information for each link:
 - a. The identification of the Owner site as specified by the end-user.
 - b. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - c. The overall Pass/Fail evaluation of the link-under-test.
 - d. The name of the standard selected to execute the stored test results.
 - e. The cable type and the value of NVP used for length calculations.
 - f. The date and time the test results were saved in the memory of the tester.
 - g. The brand name, model and serial number of the tester.
 - h. The identification of the tester interface.
 - i. The revision of the tester software and the revision of the test standards database in the tester.
 - j. The test results information must contain information on each of the required test parameters that are listed in this Section.

6. The detailed test results data to be provided in the electronic database for each tested link must contain the following information:
 - a. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. In this case, the PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
 - 1) Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m (1) and the test limit value.
 - 2) Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.
 - 3) Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value.
 - 4) Attenuation: Minimum test results documentation for the worst pair.
 - 5) Return Loss: Minimum test results documentation for the worst pair as measured from each end of the link.
 - 6) NEXT, ELFEXT, ACR: Minimum test results documentation for the worst pair combination as measured from each end of the link.
 - 7) PSNEXT, PSELFEXT, and PSACR: Minimum test results documentation for the worst pair as measured from each end of the link.

B. Optical Fiber Test Result Documentation

1. Test results saved within the field-test instrument shall be transferred into a Windows-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e. "as saved in the field-test instrument". The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.
2. The test results documentation shall be available for inspection by the Owner or the Owner's representative during the installation period and shall be passed to the Owner's representative within 15 working days of completion of tests on cabling served by a telecommunications room or of backbone cabling. The installer shall retain a copy to aid preparation of as-built information.
3. The database for the complete project shall be stored and delivered on two sets of CD-ROM's prior to Owner acceptance of the building. This CD-ROM shall include the software tools required to view, inspect, and print any selection of the test reports.
4. The detailed test results documentation data is to be provided in an electronic database for each optical fiber and shall contain the following information. Additionally, provide one (1) paper copy of the following detailed test result documentation in a three ring binder. The binder shall be organized with labeled sections sorted by test type and optical fiber circuit ID number.
 - a. The identification of the Owner site as specified by the end-user.
 - b. The name of the test limit selected to execute the stored test results.
 - c. The name of the personnel performing the test.
 - d. The date and time the test results were saved in the memory of the tester.
 - e. The manufacturer, model and serial number of the field-test instrument.
 - f. The version of the test software and the version of the test limit database held within the test instrument.

- g. The fiber identification number. Circuit IDs reported by the test instrument should match the specified physical label ID.
- h. The reference test set up.
- i. The type of optical fiber tested.
- j. The direction of the measurement.
- k. The length for each optical fiber.
 - 1) Optionally the index of refraction used for length calculation when using a length capable OLTS.
- l. Test results to include OLTS attenuation link measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
- m. Test results to include OTDR link traces and event tables at the appropriate wavelength(s). The connector and splice loss data shall be identified in the traces.
- n. The length for each optical fiber as calculated by the OTDR.
- o. The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.

3.3 RECORD DRAWING OPTICAL FIBER ROUTING DOCUMENTATION

- A. The following documentation shall be provided on record drawings for optical fiber route diagrams:
 - 1. Fiber routing
 - 2. Splice locations
 - 3. Patch panel types, capacities, and locations
 - 4. Terminations and connector locations
 - 5. Cable lengths (including slack)

END OF SECTION 270800

SECTION 271116 - COMMUNICATION CABINETS, RACKS, FRAMES AND COMPONENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section provides the minimum requirements for communications cabinets, racks, frames, and components for a premise wiring system with a complete channel.

1.3 SUBMITTALS

- A. Product Data: For technology cabinets, racks, frames, managers and components. Provide specifications, installation and instructions, dimensional data, capacities, materials, and configurations.
- B. Shop Drawings: Include dimensional plans, sections, and elevations. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Include equipment relay rack elevations and plan diagrams indicating layout in Telecommunications Rooms.

1.4 QUALITY ASSURANCE

- A. Material and work specified herein shall comply with the applicable requirements of:
 - 1. TIA-942 – Telecommunications Infrastructure Standard for Data Centers
 - 2. ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard, 2000-2004.
 - 3. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces, 2004
 - 4. ANSI/TIA/EIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, 2002
 - 5. ANSI-J-STD-607-A Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002
 - 6. NFPA 70 – National Electric Code, 2005
 - 7. BICSI – Telecommunications Distribution Methods Manual, latest edition

PART 2 - PRODUCTS

2.1 EQUIPMENT RACK

- A. The equipment racks shall be provided in the Telecommunication Rooms or other areas as shown on the drawings.
- B. The rack shall conform to EIA standards with 19 inch width. The rack height shall be 96 in.
- C. The rack system shall be Chatsworth Two Post Rack 48353-X15.

2.2 FRONT HORIZONTAL CABLE MANAGER

- A. The horizontal cable manager shall be of metal construction and two rack units in height.

- B. The horizontal cable manager shall mount to any standard EIA 19 in. rack.
- C. The horizontal cable manager shall have four plastic modular snap in D-rings mounted to the front of the panel standard. The D-rings shall measure 3 in. by 3 in.
- D. The horizontal cable manager shall have cable pass through holes in the panel for ease of installation and maintenance.
- E. Provide two (2) strain relief clips on each front horizontal manager located on each end of the panel. Strain relief clips shall be two (2) rack units high.
- F. Provide Molex 25.B013G horizontal cable manager.

2.3 REAR HORIZONTAL CABLE MANAGER

- A. The rear horizontal cable manager shall consist of one piece construction that is molded out of plastic.
- B. The rear horizontal cable manager shall be two rack units in height.
- C. The rear horizontal cable manager shall mount to any standard EIA 19 in. rack.
- D. The rear horizontal cable manager shall include integral bend radius control and flexible fingers with rounded edges.
- E. The rear horizontal cable manager shall have cable pass through holes in the panel for ease of installation and maintenance.
- F. A removable dual hinged cover shall be provided that opens upward or downward for access to the cables.

2.4 VERTICAL CABLE MANAGER

- A. Vertical cable manager shall be Chatsworth 30095-715.

2.5 REAR VERTICAL CABLE MANAGER

- A. Rear vertical cable managers shall consist of individual cable management rings attached to the rear of the rack at regular intervals.
- B. The cable manager shall be compatible with EIA-310 standard racks for installation on rack rails.
- C. The cable managers shall be one (1) rack unit high, 2 in. wide, and 5 in. deep.
- D. The cable manager ring shall be slotted to permit installation and removal of cabling.

2.6 CABLE WATERFALL DROP OUT

- A. The cable waterfall drop out shall provide bend radius control in vertical and horizontal directions for cables dropping out of overhead cable trays above equipment racks.
- B. The cable waterfall drop out shall secure to the rung or stringer of the ladder rack with cable ties.

- C. The cable waterfall drop out shall be constructed of glass filled flame retardant nylon and meet UL94V-0 requirements.
- D. The cable waterfall drop out shall be RoHS compliant and black in color.

PART 3 - EXECUTION

3.1 SYSTEM INSTALLATION

- A. Ground all systems components per ANSI/TIA/EIA 607 and project specifications.
- B. Securely mount all equipment relay racks to the floor and overhead cable trays as required.
- C. Provide the cable tray layout as shown on the drawings.
- D. The cable tray shall be mounted above the installed height of the equipment racks. Waterfall cable drops shall be provided on the cable runway, one above each side of each rack, for dressing of cables down the back side of each rack.
- E. The Contractor shall provide racks for data equipment and station data cabling termination. Each rack will have wire management front and rear as specified. All racks are to be free standing, secured both to the IDF floor and to the overhead cable runway. Fiber optic building feed is to be located in one rack, which may also house the electronics for the building at the Owner's discretion.
- F. For each equipment rack installed, including those designated for future or left empty by the contractor, provide the following components:
 - 1. One EIA standard 19 in. wide by 96 in. two post high heavy duty free standing equipment rack.
 - 2. Two front vertical cable managers, one on each side, spanning the complete height of the rack. Where racks are adjacent in a row, there shall be a total of two front vertical managers between them.
 - 3. Two front horizontal cable managers shall be provided at the top of each rack. Each front horizontal cable manager shall have two (2) strain relief clips affixed to the front, one on each side of the panel, for dressing of patch cords.
 - 4. Cable drop out waterfall devices shall be provided above vertical cable managers.
 - 5. Grounding equipment shall include paint-piercing grounding washers used at both sides of each bolt point, and antioxidant gel shall be used on each grounding washer. One rack grounding strip shall be mounted on the right hand rear side of each rack, and one electrostatic discharge port shall be provided over the grounding strip, at approximately 5' AFF.
 - 6. Provide two 125 Volt, 20 Amp rack mount power strips (CPI 12816-707) per telecommunications equipment rack.

END OF SECTION 271116

SECTION 271123 - COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 DESCRIPTION

- A. This specification section describes the type of cable runway to be used above racks and on walls in the MDF and IDF rooms.
- B. Coordinate installation and final placement above racks with Owner.
- C. Provide necessary fittings, supports, and other hardware, which may be required to provide a complete installation. The complete systems shall be assembled from factory supplied parts.
- D. Coordinate the exact location of all cable trays with all other trades in order to avoid space conflicts or to avoid interference with the designed flow of air.

PART 2 - PRODUCTS

2.1 TELECOMMUNICATIONS ROOM CABLE TRAY (CABLE RUNWAY)

- A. Cable runway shall have C-channel stringer style with 1-1/2" stringers.
- B. Provide width as shown on the drawings.
- C. Supports shall be positioned as recommended by manufacturer and anchored to the building structure.
- D. Cable runway shall be steel and meet ASTM A570.
- E. Cable runway shall be finished black.
- F. Bond each cable runway joint with a UL listed grounding device and ground tray according to manufacturer's recommendations to maintain UL and NEC grounding requirements and listings.
- G. Provide Chatsworth ladder rack – minimum 12" wide (10250-712), Butt-splice kit (11301-701), Junction splice kit (11302-701), 3" channel rack to ladder mounting plate (12730-712), wall angle support kit (11421-712) and additional accessories as necessary.
- H. Cable tray shall support a minimum of 40lbs/linear foot.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cable runways using hardware, splice connectors, support components, joint ground bonding, and accessories available from the manufacturer. Provide all accessories for complete installation that is approved by the Engineer.

- B. Cable tray shall be installed on walls, racks, and supported frame structure as required.
- C. Cable tray shall be installed below the finished ceiling above the equipment racks.
- D. Maintain 4" separation between category 6 cabling and any type of power cabling.
- E. Cable tray shall be bonded to telecommunications grounding system.

END OF SECTION 271123

SECTION 271313 - COPPER MULTI-PAIR BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 GENERAL

- A. This section lists the equipment required for telephone cable for voice interbuilding and Intrabuilding backbones. This cable must be installed from every IDF to MDF. Daisy-chaining of the cable in IDF's is not permitted.
- B. This cable shall have plenum rating as is specified in the project documents, unless it is installed in conduit.
- C. In the MDF's and IDF's, this cable shall be punched down on 110 blocks and cross connected to rack as required and as shown on the drawings.
- D. The riser cables shall be labeled and documented in accordance with Montgomery College Labeling Standards.

PART 2 - PRODUCTS

2.1 INTRABUILDING MULTI-PAIR BACKBONE CABLE

- A. Solid conductor insulation shall be color coded to Telephone Industry Standards.
- B. Tie cable shall be Superior Essex OSP Cat5 MEGAPIC-NF-040104-31 (100 pair) and UTP category 5e 25 pair 51-478-48.
- C. Outside plant cabling shall be Mohawk Outside Plant 4 pair category 5e copper cable M57562.
- D. Rack mount 110 blocks shall be Molex category 6 station voice KPD-00080 and KPD-00061 for category 5e tie cable.
- E. Vertical voice riser cabling shall be in 25 pair bundles, terminated on rack mounted 110 blocks.
- F. Provide 10 ft service loops at both ends of the cable.
- G. Risers shall be secured to cable supports at each floor to relieve stress on cable and to support the weight.

2.2 BUILDING ENTRANCE PROTECTOR

- A. The protector shall be used at both building entry points to protect the building against lightning induced transients.
- B. The protector shall have an input splice chamber with 110 wiring block.
- C. The box shall have a cover.
- D. The equipment shall use plug-in protector modules.

- E. The equipment shall have input on 110 wiring block, the output is on 110 wiring block, and the pair size shall be 100, 50, or 25 as required. The cover is to be provided.
- F. Acceptable manufacturer is PortaSystems 25025-110-M110PC, Circa 1880ENA1/NSC-50.

2.3 PLUG-IN PROTECTOR MODULES

- A. The modules must plug into the building entrance protectors.
- B. The protector modules shall operate at DC voltages at 240 volts. It shall use solid state protection and heat coils.
- C. Acceptable manufacturers are PortaSystems and Circa 4B6FS-240e.

2.4 PUNCHDOWN BLOCK

- A. This equipment shall be used to punch down this cable in all demarc locations.
- B. This equivalent shall be rack mounted 110 punchdown blocks as shown on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The equipment in various buildings shall be installed on the drawings.
- B. Proper grounding must be provided as required by UL and NEC.
- C. Provide wire distribution spools or approved wire management for crossconnect wiring.

END OF SECTION 271313

SECTION 271323 - OPTICAL FIBER BACKBONE CABLING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 DESCRIPTION

- A. This section provides the specifications for all the work related to the fiber optic system in the project. The testing of fiber optics is described in another section.
- B. The Owner shall be provided with a minimum 25 year Application Assurance Warranty covering the cost of all material and labor. The warranty will guarantee the following and other applications: 10 BASE – T, 100 BASE – T, 1000 BASE-T, 1000 BASE-TX, 155 MBPS ATM, 16 MBPS Token Ring. The Technology Contractor must be certified by the cable plant manufacturer for a minimum of 60 days prior to submission of the bid and must have installed at least two (2) similar systems by the proposed connectivity manufacturer.

1.2 APPLICABLE DOCUMENTS

- A. The following documents of latest issue form a part of this specification to the extent specified herein.
 - 1. EIA-STD-RS-455: Standard Test Procedures for Fiber Optic, Fibers, Cables, Transducers, Connecting and Terminating Devices.
 - 2. EIA-STD-RS-359: Standard Colors for Color Identification and Coding.
 - 3. MIL-STD-202: Test Methods for Electronic and Electrical Component Parts.
 - 4. MIL-STD-454: Standard General Requirements for Electronic Equipment.
 - 5. MIL-STD-810: Environmental Test Methods and Engineering Guidelines.
 - 6. UL Subject 1666: Standard Flame Test for Flame Propagation Height of Electrical and Optical Cable Installed Vertically in Shafts.
 - 7. EIA/TIA –STD-455 for fiber optic cables.

PART 2 - PRODUCTS

2.1 OPTICAL FIBER CABLE

- A. Provide Sumitomo tubes: 2 tube (TC02MTOX), 4 tube (TC04TOX), 7 tube (TC07TOX), 19 tube (TC19TOX), and clear tube from distribution unit to fiber box.
- B. Provide fiber: single mode 6, 12, 18, or 24 strand; multimode 50 micron (FB18GB55) 6, 12, 18, or 24 strand.
- C. Provide SC connectors.
- D. Provide DE12IDU tube distribution box.
- E. Provide Sumitomo fiber box FT03RU8P, single mode 12 pack FTSC06D1, and 10G multi-mode 12 pack FTSC06D4. Provide Sumitomo splice trays within fiber box.

2.2 FIBER PATCH PANELS

- A. This equipment shall be used for the termination of fiber cables.
- B. The equipment shall be rack mountable. It shall contain a mounting stud for a maximum of two 10" splice trays.
- C. The equipment shall include rear corner slots for cable entry, wire retainers for holding the buffered fiber in place, and fiber storage drums for maintaining a bend radius of 1.5 inches for the buffered fiber.
- D. Provide clear cover over the panel.
- E. The enclosure shall be of 16 ga. cold rolled steel construction with black powder coat finish.

2.3 SC TYPE CONNECTOR, SINGLEMODE AND MULTIMODE FIBERS

- A. Provide SC type factory terminated connectors and pigtails for all singlemode and multimode fiber strands.
- B. All fiber optic strands shall have pigtails, with the appropriate connector fusion spliced to the end of the strand.
- C. The connector shall have keyed insertion and be spring loaded for physical contact coupling.
- D. The connector shall have a bayonet latch for easy on/easy off.
- E. The connector shall have high quality PC zirconia DC style ferrules.
- F. The connector insertion loss shall be less than 0.5 dB for multi-mode fibers and less than 0.35 dB for singlemode fibers.
- G. The pigtail length shall be minimum 3 m long.
- H. Provide SC connector color per the Owner's standard.

2.4 ADAPTER PANELS

- A. Provide adapter panels to house SC type adapters and connectors in fiber patch panels. Provide SC adapter colors per the Owner's standard. Provide color and simplex or duplex configuration per the Owner's standard.
- B. SC adapters shall be secured with screws. The adapters shall have precision zirconia ceramic sleeves.
- C. The adapter shall be constructed with a durable black powder coat finish.

PART 3 - EXECUTION

3.1 GENERAL

- A. All fiber installation must be in accordance with all applicable standards and manufacturer's recommendations.

- B. All fiber cables inside the building, whether in conduit or not, must be run in Sumitomo FutureFlex tube cables with proper labeling.
- C. Refer to Testing of Fiber Optic System Section for testing of fiber optic cables.
- D. All fiber cables shall be in Sumitomo FutureFlex dielectric tube cabling in manholes and shall be clearly marked with permanent labels.
- E. All fibers shall be properly terminated and tested.

3.2 WARRANTY

- A. Provide system installed in accordance with all applicable standards and manufacturer's recommendations. Fiber shall be properly terminated and tested, warranted against all defects including material and labor for a twenty-five (25) year warranty period in accordance with the required manufacturer's warranty for application assurance, parts, and labor through Sumitomo FutureFLEX Air-Blown Fiber (ABF) cable plant.

END OF SECTION 271323

SECTION 271513 – COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 GENERAL

- A. All components shall be guaranteed by the manufacturers to operate to the TIA/EIA Category 6 standard when installed. The complete channel shall conform to this standard where the channel is defined as all cabling, patch panels, and jacks.
- B. The Owner shall be provided with a minimum 25 year Application Assurance Warranty covering the cost of all material and labor. The warranty will guarantee the following and other applications: 10 BASE – T, 100 BASE – T, 1000 BASE-T, 1000 BASE-TX, 155 MBPS ATM, 16 MBPS Token Ring. The Technology Contractor must be certified by the cable plant manufacturer for a minimum of 60 days prior to submission of the bid and must have installed at least two (2) similar systems by the proposed connectivity manufacturer.
- C. The data, voice and video cabling inside the buildings is to be TIA/EIA 568 Category 6 cable. All connecting hardware, including patch panel connectors and patch cords, shall provide performance as specified in the TIA/EIA 568 Category 6 standard. All cables shall be plenum rated unless noted otherwise. All Category 6 connecting hardware shall be manufactured by the same manufacturer.
- D. Fiber optic cabling is specified under another section in this document.
- E. All the components shall be approved components per the cabling system manufacturer, so that the required warranty can be provided by the specified manufacturers.
- F. HORIZONTAL CABLING DESCRIPTION
 - 1. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
 - 2. Horizontal cabling shall contain no more that one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
 - 4. Splitters shall not be installed as part of the optical fiber cabling.
 - 5. A work area is approximately 100 sq. ft. (9.3 sq.m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
 - 6. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

PART 2 - PRODUCTS

2.1 CATEGORY 6 UTP Cable

- A. Provide Molex data cabling CAA-0181P-BL (Blue) and Molex voice cabling (CAA-0181P-02 (white).
- B. The premise wiring shall consist of 4 pairs of unshielded twisted pairs
- C. The cabling shall operate in accordance with the Category 6 TIA/EIA standard
- D. The conductor shall be 24 AWG, 23 AWG, or 22 AWG solid bare copper.
- E. The cable shall have plenum insulation with ripcord.
- F. Description: 100-ohm, 4-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
- G. Comply with ICEA S-90-661 for mechanical properties.
- H. Comply with TIA/EIA-568-B.1 for performance specifications.
- I. Comply with TIA/EIA-568-B.2, Category 6.
- J. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - 1. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.2 UTP CABLE HARDWARE

- A. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- B. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
 - 1. Category 6 110 rack mounted wiring blocks shall be provided for termination of some voice cables and paging system cables in the Telecommunications Rooms.
 - 2. The Category 6 110 style wiring block shall meet the following criteria:
 - a. Sized for 100 pr or 300 pr termination fields.
 - b. Be rack mounted and provide cable management troughs.
 - c. Terminate 22 through 26 AWG wires on 3, 4, or 5 pair sizes.
 - 3. Must conform to ANSI/TIA/EIA 568 standards.
 - 4. Label 110 blocks with manufacturer provided labels.
 - 5. Provide 100 pair C-5 clips; as required.

- C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Telephone Riser cabling shall terminate on 110 blocks within the MTS.
 - 2. Telephone riser cabling extending to IDF's shall terminate on the back of patch panels.

- D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Patch panels shall be 24 or 48 port panels as indicated. Provide quantity as required plus spares and blank positions adequate to suit specified expansion criteria.
 - 2. Provide clear plastic cover to protect the circuit board.
 - 3. Patch panels shall be equipped with rear cable management bar.
 - 4. Patch panels shall be provided within the Telecommunication Rooms and MTS for the termination of category 6 cabling. Category 5e riser cabling extending to IDF's from the MTS shall terminate on the patchpanel and be interconnected.
 - 5. Patch panel shall exceed TIA/EIA B.2-1 and IEC 60603-7-4 for component performance.
 - 6. Terminate 4 pair category 6 cables on 110 style connection wired per TIA/EIA 568B wiring.
 - 7. Provide icons on patch panels as well as labels for easy identification.
 - 8. Provide Molex patch panels PID-00142 (data).

PART 3 - EXECUTION

3.1 SYSTEM INSTALLATION

- A. All these devices shall be installed in strict conformity with the structured cabling system manufacturer's requirements and TIA/EIA 568 standards.
- B. The wiring shall be installed with adequate slack in all pull boxes. There should be a service loop of no less than 5 feet in the floor closet.
- C. The wiring shall be neatly dressed and bundled on one side of the mounting board or the rack.
- D. Provide cable testing as required.
- E. Voice and Data cabling shall be continuous runs, with no splices.
- F. Length shall not exceed 295 feet or 90 meters.
- G. Service loops shall be 10 ft at both ends of the cabling. Service loops at the work area end of the cable shall be provided above the ceiling. Service loops within the IDF or MDF shall be neatly coiled and secured in the ladder tray.

END OF SECTION 271513

SECTION 271533 - COMMUNICATIONS CABLE TELEVISION CABLING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 DESCRIPTION

- A. This section lists the equipment that is required for the CATV wiring in the building as well as MCTV.
- B. For testing purposes, the Contractor shall use a sweep generator.
- C. In each location inside the building, the CATV shall be home run to a directional coupler port in the IDF. No daisy-chaining of CATV wiring to the station locations is permitted.
- D. Provide distribution amplifiers, splitters, wall plates, plugs, etc., as required.
- E. Provide power to distribution amplifiers.
- F. Provide signal quality at every outlet as specified.
- G. Install CATV female socket with double nuts. The color of the wall plate and all other raceway that is surface mounted shall be exactly the same and approved by the Owner.
- H. The cable for the reverse video cable trunk system shall be installed without amplifier distribution system.
- I. Terminate all CATV cables in F-connector on wall splitters. Provide jumper cables to splitters on the walls and elsewhere.
- J. Provide all amplifiers for the forward CATV trunks.
- K. Provide MCTV connections as required and indicated on drawings. Coordinate with MCTV standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide Commscope trunk cable P3500JCASS.
- B. Outside plant cabling shall be Commscope AZ2604221.
- C. Provide Blonder Tongue 8 port splitter and amplifiers.

- D. Provide Belden RG6 horizontal coaxial cable type 1695A RG-6/U, 18 AWG solid 0.40" bare conductor, gas-injected foam HDPE insulation, Duofoil + tinned copper braid shield (95% coverage), PVC jacket.
- E. Provide Belden RG11 vertical coaxial cable type 7731A (white).
- F. Provide Molex coaxial f-connector MSY-00002-02.
- G. Indoor ITV AV Wallbox:
 - 1. Provide EIA compliant 19" low-profile wall mount rack. Body and backpan of rack shall be constructed of 18 gauge steel.
 - 2. Rackrail shall be 11 gauge steel with threaded 10-32 holes in universal EI spacing and shall accommodate 4 usable rack spaces.
 - 3. Mounting brackets shall be 14 gauge steel.
 - 4. Hinged top shall be 16 gauge steel. Hinged top and center section shall operate on separate locks but with similar key.
 - 5. Rack shall be pretreated with phosphate and finished in durable black powder coat.
 - 6. Weight capacity shall be 150lbs.
 - 7. Electrical knockouts in backpan shall accommodate ½" and 1-1/2" conduit. Laser knockout on backpan shall accommodate larger cable bundles. Rack shall be of fully welded construction.
 - 8. Rack shall be UL listed and GREENGUARD Indoor Air Quality Certified for Children and Schools, as well as RoHS EU Directive 2002/95/EC compliant. Rack shall be manufactured by ISO 9001 and ISO 14001 registered company.
 - 9. Rack shall be warranted to be free of defects in material and workmanship under normal use and conditions for the lifetime of the rack.
 - 10. Rack shall be mounted horizontally, allowing the door to fold down to the floor.
 - 11. Back of rack shall be recessed into the wall, still allowing the door to attach and lock to back of the rack.
 - 12. Product shall be as manufactured by Middle Atlantic – WRS Series 19" low-profile wall-mount racks.
- H. Outdoor ITV AV Wallbox:
 - 1. Provide 16 gauge weatherproof box at exterior ITV location.
 - 2. Box shall contain 19" wide rack to accommodate the Gepco HMP8-Bxx 304M breakout rack and 19" wide I/O panel housing the XLR and ST fiber connections.
 - 3. Box shall provide 8" space from the back of I/O panel to the back of the rack.
 - 4. Box shall provide 8" clear space from the front of the I/O panel (with the door closed) to the inside of the door.

5. Provide knockouts on the top of the rear are of the box to allow interface with conduit containing fiber, power, and XLR cables to connect to the back of the I/O panel inside.
 6. Cabling extending through the front of the rack shall connect through the door located on the bottom of the box with the front door closed. Doors shall operate on separate locks but with similar key.
 7. Front door shall not have a window or venting.
 8. Box height shall accommodate the number of I/O panels required.
- I. ITV fiber connectors shall be ST type terminated on a Gepco HMP8-Bxx 304M breakout rack or bulkhead end.
 - J. MCTV SMPTE fiber camera cable feed for input/output panel shall be Gepco HMP8-Bxx 304 M breakout rack using ST connections for the plenum rated single mode fiber (FSD08P) for use with Yellowbrik fiber transceiver system and LEMO plugs or socket SMPTE fiber connections.
 - K. Audio cabling shall be plenum rated 1801B plenum rated Belden analog and digital rated audio cable.
 - L. Audio connectors shall be Neutrik NC3FD-LX 3 pole female at each I/O location within the building; Neutrix NC3MD-LX 3 pole male at the Input/Output panel at the ITV truck location. Provide SCM dust protection cover for male chassis connections on the I/O panel near the MCTV television truck when not in use.
 - M. HD Electrical Cable for each channel/camera between a Gepco HMP8-B4P-STH 304M breakout rack to Gepco HMP8-B8S-STH 304M Breakout rack (at truck location) shall be the plenum rated HDP221P. Provide one cable per channel/camera connection. Where four connections are required, provide four cables between the locations. (Diameter shall be 0.205in). Connector shall be 6-position MATE-N-LOCK Connector to provide power for the I/O SMPTE fiber connections (Each channel shall require two plugs).
 - N. Provide miscellaneous items (provide quantity of each as required):
 1. Connector, Soft Shell; 6; 600 VAC; Plug; Double-Row; Nylon; Plug; Natural cable end TE 172168-1
 2. Connector, Soft Shell; 6; 600 VAC; Receptacle (Cap); Double-Row; Nylon; Natural Rack end TE 172160-1
 3. 18 AWG termination pin for terminating two power conductors and one ground inside of the Mate-N-Lok 6 position plug: MATE-N-LOK Connectors; 20-16a AWG; Socket TE 171639-1
 4. 24 AWG termination pin for terminating two signal conductors inside of the Mate-N-Lock 6 position plug: MINI UNIVERSAL M-N-L PIN LP TE 170363-1
 5. Gepco Single-mode, plenum rated, fiber optic cable (FSD08P) terminated in ST type fiber terminator.
 6. ST feed-through connector allowing ST fiber connection on each side: Gepco/Senko 216-101-E.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate installation with MCTV standards.
- B. The picture quality for the CATV drops in the buildings shall be TASO 1 or 2. The signal level at this point shall be between +0 and +15 dBmV.
- C. The picture quality in the riser system shall be TASO 1, and the signal level shall be at least 10 to 15 dBmV.
- D. The signal level on the riser at any point shall not exceed +46 dBmV.
- E. Sweep testing is required prior to signoff.
- F. Provide grounding blocks for CATV cable where required by NEC.
- G. Provide all terminating resistors at drops that are unused and do not have directional couplers.
- H. Label cabling per college standard.

END OF SECTION 271533

SECTION 271543 – COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL

- A. All components shall be guaranteed by the manufacturers to operate to the TIA/EIA Category 6 standard when installed. The complete channel shall conform to this standard where the channel is defined as all cabling, patch panels, and jacks.
- B. The Owner shall be provided with a minimum 20 year Application Assurance Warranty covering the cost of all material and labor. The warranty will guarantee the following and other applications: 10 BASE – T, 100 BASE – T, 1000 BASE-T, 1000 BASE-TX, 155 MBPS ATM, 16 MBPS Token Ring.
- C. The data and phone cabling inside the buildings is to be TIA/EIA 568 Category 6 cable. All connecting hardware, including connectors and patch cords, shall provide performance as specified in the TIA/EIA 568 Category 6 standard. All Category 6 connecting hardware shall be manufactured by the same manufacturer.
- D. Fiber optic cabling is specified under another section in this document.
- E. All the data system components shall be for operation and use with structured cabling system as manufactured by the specified manufacturers.
- F. All the components shall be approved components per the cabling system manufacturer, so that the required warranty can be provided by the specified manufacturers.

PART 2 - PRODUCTS

2.1 DATA OUTLETS/JACKS

- A. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
 - 1. The data outlets shall be used for bandwidth of up to the highest MHz rating proposed by the Category 6 standard. Jacks shall exceed TIA/EIA B.2-1 and IEC 60603-7-4 for component performance
 - 2. The wire terminations shall be in accordance with T568B wiring standard.
 - 3. The material of construction shall be high impact flame retardant UL rated 94V-0 thermoplastic.
 - 4. Provide jacks and connectors for audiovisual components as required.
 - 5. Jacks shall be KSJ-00018-BL (blue for data), KSJ-00018-02 (white for voice), KSJ-00018-08 (gray for MCFNET).

2.2 FACE PLATES

- A. Blank off all unused positions. (Blanks shall be white Molex KSJ-00005-02)

- B. Provide Molex faceplates:
 - 1. 2 port – WSY-00018-02
 - 2. 4 port – WSY-00002-02
 - 3. 6 port – WSY-00001-02
 - 4. Biscuit – SSY-00002-02
- C. All modular jacks shall mount flush in the face plate.
- D. Provide labels on all telecommunications outlets. Labels shall be typed indicating tags based on the district identified labeling scheme defined elsewhere.
- E. The connector shall be wired per TIA/EIA T568B.
- F. Wall mounted telephone outlets shall provide screwtype knobs on a stainless steel plate for attaching the telephone.
- G. All recessed outlet boxes to be double gang.
- H. Fill faceplate positions starting in the upper left and going right and then down.
- I. Coordinate locations of devices to coordinate with electrical plans.
- J. Faceplates for telecommunications outlets mounted in surface mounted raceway shall maintain the outlet configurations indicated on the drawings. Faceplate colors shall match surface mounted raceway.

PART 3 - EXECUTION

3.1 SYSTEM INSTALLATION

- A. Provide blue data jacks mounted in the upper openings of faceplates, filling from left to right. White voice jacks shall fill the lower positions in the faceplate, from left to right. Where blanked off openings, or spare openings exist, these shall be provided in the center row of the faceplate, and shall then fill all unused positions.
- B. All these devices shall be installed in strict conformity with the structured cabling system manufacturer's requirements and TIA/EIA 568 standards.
- C. The wiring shall be installed with adequate slack in all pull boxes. There should be a service loop of no less than 5 feet in the floor closet.

END OF SECTION 271543

SECTION 271619 - COMMUNICATIONS PATCH CORDS, STATION CORDS, AND CROSS CONNECT WIRE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL

- A. All components shall be guaranteed by the manufacturers to operate to the TIA/EIA Category 6 standard when installed. The complete channel shall conform to this standard where the channel is defined as all cabling, patch panels, and jacks.
- B. All the data system components shall be for operation and use with structured cabling system as manufactured by the specified manufacturers.
- C. All the components shall be approved components per the cabling system manufacturer, so that the required warranty can be provided by the specified manufacturers.
- D. The patch cords shall have stranded and not solid conductors.
- E. All data drop cords shall be Category-6 rated and equipped with RJ-45 modular plugs. Refer to the detailed engineering drawings and schedules for quantities and types to be provided.
- F. Data drop and patch cords shall consist of #24 AWG, solid or stranded as applicable, insulated, Category-6 conductors formed into four individually twisted pairs and enclosed in a jacket.
- G. All drop and patch cords must not degrade the required channel performance characteristics as per the latest ratified release of ANSI/TIA/EIA-568.
- H. All drop and patch cords shall be configured with straight-through pinning (wired T568-B).
- I. All cords shall be transferable to any channel without degrading the channel or system performance. In order to maintain certification cords shall not be required to remain on the channel where tests were performed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products produced by one of the following manufacturers:
 - 1. Molex
 - a. Category 6 patch cord, blue color, 5 ft in length, Molex PCD-00202-OH
 - b. Category 6 patch cord, blue color, 10 ft in length, Molex PCD – 00204-OH
 - c. Category 6 patch cord, blue color, 15 ft in length, Molex PCD-00205-OH

2.2 PATCH CORDS/STATION CORDS

- A. Patch Cords: Factory-made, four-pair cables in lengths coordinated with the rack layouts and configurations; terminated with eight-position modular plug at each end, compatible with all data and voice applications.
- B. Patch cords shall have color-coded boots for circuit identification. The patch cord is used in Telecommunication Rooms and MDF.
- C. Provide quantity of patch cords to equal number of category 6 outlets installed plus 50%. Coordinate lengths of patch cords within MDF and IDF's to match telecommunications equipment layouts. Excessive lengths are unacceptable.
- D. The quantity of Category 6 patch cords required to be provided in the MDF/Telecommunication Rooms shall match the total quantity of Category 6 horizontal cables terminated in the MDF/IDF's.
- E. The cable must meet the requirements of TIA/EIA 568 Category 6 standard.
- F. Provide snagless boots over jacks.
- G. Patch cord quantity distribution:
 - 1. Telecommunications Rooms:
 - a. Provide one (1) patch cord to match cable and jack assembly Category rating per port on the patch panel.
 - b. Provide 50% of patch cord quantity blue color, 3 meters in length.
 - c. Provide 50% of patch cord quantity blue color, 1.5 meters in length.
 - 2. Workstation Outlets:
 - a. Provide one (1) patch cord to match cable and jack assembly category rating per eight position modular jack.
 - b. Provide 45% of patch cord quantity blue color, 3 meters in length.
 - c. Provide 45% of patch cord quantity blue color, 5 meters in length.
 - d. Provide 10% of patch cord quantity blue color, 8 meters in length.

2.3 FIBER OPTIC PATCH CORDS

- A. Fiber optic patch cords shall be utilized within the MTS/IDF.
 - 1. Provide for each single mode jack a duplex SC to LC 15 ft jumper patch cord.
 - 2. Provide for each multimode jack a duplex SC to LC 50 micron 15 ft jumper patch cord.

PART 3 - EXECUTION

3.1 SYSTEM INSTALLATION

- A. All these devices shall be installed in strict conformity with the structured cabling system manufacturer's requirements and TIA/EIA 568 standards.
- B. The wiring shall be neatly dressed and bundled on the mounting board or the rack.
- C. Provide cable testing as required.

END OF SECTION 271619

SECTION 275100 – DISTRIBUTED AUDIO-VISUAL COMMUNICATION, SECURITY SUPPLEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to 280500 Part 1

1.2 DESCRIPTION OF WORK

- A. Refer to 280500 Part 1

1.3 RELATED DIVISION PROVISIONS

- A. Refer to 280500 Part 1

1.4 REFERENCES

- A. Refer to 280500 Part 1

1.5 SUMMARY

- A. Section includes requirement of Division 28 Security contractor to support electronic security systems work. This section provides requirements for planning, supplementary submittal requirements, product specifications and installation of conduit and electrical power systems supporting electronic security.

1.6 DEFINITIONS

- A. Refer to 280500 Part 1

1.7 SUBMITTALS

- A. Refer to 280500 Part 1

1.8 COORDINATION

- A. Refer to 280500 Part 1

1.9 QUALITY ASSURANCE

- A. Refer to 280500 Part 1

1.10 MAINTENANCE & SERVICE

- A. Refer to 280500 Part 1

1.11 SYSTEM DESCRIPTION

- A. The system shall be coordinate with 280500.

1.12 PERFORMANCE REQUIREMENTS

- A. Refer to 280500 Part 1

1.13 DELIVERY HANDLING & STORAGE

- A. Refer to 280500 Part 1

1.14 PROJECT CONDITIONS

- A. Refer to 280500 Part 1

1.15 EQUIPMENT AND MATERIALS

- A. Refer to 280500 Part 1

1.16 ELECTRICAL POWER

- A. Refer to 280500 Part 1

1.17 ENVIRONMENTAL CONDITIONS

- A. Refer to 280500 Part 1

1.18 LIGHTNING, POWER SURGES, & GROUNDING

- A. Refer to 280500 Part 1

- 1.19 COMPONENT ENCLOSURES
 - A. Refer to 280500 Part 1

- 1.20 ELECTRONIC COMPONENTS
 - A. Refer to 280500 Part 1

- 1.21 SUBSTITUTE MATERIALS & EQUIPMENT
 - A. Refer to 280500 Part 1

- 1.22 LIKE ITEMS
 - A. Refer to 280500 Part 1

- 1.23 WARRANTY
 - A. Refer to 280500 Part 1

- 1.24 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)
 - A. Refer to 280500 Part 1 and Part 2

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Ramtel – No Exceptions

2.2 EXISTING SYSTEMS

- A. The emergency call box units provided under the scope of this project shall be completely integrated with the existing systems.

2.3 EMERGENCY CALL BOX

- A. General – All Emergency Call Box Units provided by the Contractor shall be new and of first rate quality. Existing Emergency Call Box Units shall be removed during demolition phase and turned over to the Owner.
- B. The Emergency Call Box shall consist of an outdoor-rated, vandal resistant and ADA-compliant hands-free speakerphone communications device with a stainless steel faceplate and metal buttons. The Emergency Call Box shall one red anodized aluminum tactile button labeled "EMERGENCY" and one 0.375" diameter red light emitting diode (LED) labeled "LIGHT ON INDICATES CALL RECEIVED". The unit shall be programmable from a remote location and have a two number dialing capability, reverting to the second number if the first is busy or does not respond. The unit shall be totally hands-free on both sides after connection is initiated at site or by attendant. The unit shall be phone line powered, requiring no outside power source or battery back-up. DIP switch programming, push to talk devices, and devices requiring external power are not acceptable. The unit shall have a dedicated communication line.
- C. Construction
 1. Chassis, back box and face plate shall be constructed of stainless steel.
 2. Faceplate shall be 12 gauge #4 brushed stainless steel measuring 9.5" W x 11.75" H.
 3. Unit shall weigh approximately 8 lbs.
 4. Signage shall be constructed of cast metal with lettering and Braille raised approximately 3/32" for ADA compliance.
 5. Word "EMERGENCY" and button shall be red.
 6. Push button and switch shall be a single assembly rated for 1,000,000 cycles.
 7. Speaker and microphone shall be protected by non-ferrous metal screen to provide a barrier against vandalism, rain and snow.

D. Features

1. Unit shall be capable of operating on standard phone lines or analog PBX extensions.
2. Unit shall dial at approximately 10 tones per second.
3. Output sound level shall be greater than 80 dB at one meter for normal conversation.
4. All programming shall be stored in non-volatile EEPROM memory.
5. Button shall provide tactile feedback.
6. Unit shall be programmable from a remote telephone via keypad entry.
7. Call timer shall be programmable from 1 to 4320 minutes.
8. LED for the hearing impaired shall illuminate to indicate when calling party may speak (when receiving party is silent).
9. Unit shall be programmable with two different telephone numbers of up to 18 digits each including pauses. If first number does not answer or is busy, unit shall automatically call the second number. If that number is busy or does not answer, unit shall call the first number again. Unit shall continue alternating until call is answered or call timer limit is reached.
10. Unit shall include two auxiliary outputs and one auxiliary input that are opto-isolated from the telephone line to 1,000 volts. Outputs shall be activated, providing a dry contact closure, either automatically when Emergency Phone is activated or manually by guard keypad operation. Input shall allow unit to be activated by any device or switch that provides a contact closure.
11. Incoming and outgoing volume shall be adjustable separately.
12. Unit shall be capable of automatically notifying attendant of location via programmable 6 digit ID.
13. Unit shall be capable of silent monitoring.
14. Unit shall utilize tone dialing.
15. When call is finished, unit shall automatically shut off.
16. Unit shall answer any call placed to it from any other telephone.
17. Two levels of programmable passwords shall be available.
18. Unit shall be varistor lightning suppressed and full wave polarity guarded.
19. Unit shall have parallel tip and ring connected to an RJ-11 connector for quick installation.
20. Unit shall be compatible with RAMTEL's All Campus Alert System.
21. Unit shall comply with Part 68 of the FCC rules for the United States.

E. Environmental

1. Speaker: Unit shall have a 3.5 inch waterproof speaker with a vinyl-impregnated cloth cone. Magnet and solid aluminum voice coil area shall be protected from ferrous and non-ferrous particles by a special sealed design. The speaker shall be capable of operating without deterioration of sound quality after total immersion in water for 96 hours. Speaker shall operate at temperatures of -55°C to +85°C. Steel basket shall have a zinc dichromate finish for protection against corrosion.
2. Microphone: Unit shall include a gold, water-resistant microphone.
3. Push Button/Switch: Button and switch shall be a single assembly. Epoxy seals shall protect contacts and terminals from hostile environments and solder flux. Unit shall be waterproof and submersible to 3 feet in water. Unit shall have a mechanical life of 1,000,000 cycles. Case shall be moisture-proof, dust-tight and designed to accommodate the high shock military specifications of MIL-STD-202, method 207. Case shall be aluminum alloy, anodized clear. Button shall be red anodized aluminum. Switch shall be rated to operate from -55°C to +80°C.
4. PC boards and Other Electronic Components: Boards and components shall withstand a corrosive atmosphere of 90% H₂S for 16 hours. PC boards shall be rated R4. Unit shall be designed to operate at temperatures from -20°C to +65°C and humidity levels up to 95% relative humidity at 49°C.
5. Protective Sealing of Completed PC Boards: Once the unit has been wave soldered and inspected and the completed boards tested, the entire circuit board apparatus shall be uniformly coated by dipping rather than spraying (Mil-I416058C amend 6). The microprocessor chip shall then be installed in its socket and sealed in place with a special electrical grade RTV type sealant. At this point the boards can be sprayed with water without affecting the operation of the unit.

F. Electrical

1. Unit shall be fully phone line powered, requiring no external power or battery back-up.
2. One dedicated, twisted-shielded communication pair shall provide a minimum of 24VDC and 20mA while off hook.

G. Model

1. The emergency call box shall be a Ramtel model RR-733

H. Options

1. Contractor shall provide custom silk screening of the Owner's logo and the words "Montgomery College" on each emergency call box faceplate.
2. For indoor installations Contractor shall provide flush mount bezel produced by the call box manufacturer.

2.4 WALKWAY LED

- A. Provide walkway LED illumination for indoor wall mounted call boxes with technical features as follows:
1. Electrical:
 - a. 1W LED powered by 120V primary, 3W 350mA non-dimmable integral driver.
 - b. Input Current: 350mA
 - c. Input Voltage: 4V DC
 - d. Power Consumption: 1W
 2. Dimming: Dimmable with remote driver (not included). Consult factory.
 3. Weight: 0.99lbs (0.45kg).
 4. Material: 303 stainless steel and polycarbonate lens.
 5. Mounting: Mounts to standard 4" (102mm) octagonal box (1-1/2" (38mm) deep minimum) with flush mounted tamper proof screws.
 6. Approval: Dry locations. Approved to UL standards by CSA/US.
 7. LED Color: Blue
- B. Manufactured unit shall be MP Lighting L21 Walkway LED or approved equal.

2.5 EMERGENCY CALL BOX TOWER MOUNT

- A. Illumination
1. The tower mount has three (3) different lights.
 2. Sodium Vapor Blue Light - A high intensity 50 watt light illuminates immediate area around the tower. The blue light is continuously lit.
 3. Strobe Light - A one million candle power strobe housed in a blue Fresnel Lexan polycarbonate lens is provided. The strobe flashes continuously when the emergency call button is pushed and shuts off when the calling party hangs up.
 4. Phone Panel Light - A five (5) watt fluorescent light illuminates the emergency call box face plate.
 5. LED lighting shall be provided where option is available from manufacturer.
- B. Construction
1. 0.25" thick non-rusting, non-magnetic stainless steel
 2. Dimensions - 9' x 11" sq.

3. Weight - 175 lbs.
4. Mounting - Four (4) 5/8" x 16" J-Bolts cast into a concrete footer.
5. Color - Coordinate with Owner
6. Finish - Powder Coat (Color: Midnight Blue)
7. Graphics - "EMERGENCY" on all four sides (Color: White)
8. Graphics – Custom Silk Screen of Montgomery College Logo (Rendered in two colors, coordinate colors with Owner)
9. Power - 120 VAC

C. Model

1. The emergency call box tower mount shall be a Ramtel model PLC-8

D. Options

1. Contractor shall provide and install the optional internal heating unit offered by Ramtel.
2. Contractor shall provide and install the optional surge suppression device offered by Ramtel.
3. Contractor shall provide the optional top-mount camera arm produced by Ramtel. Camera arm shall be turned over to the Owner for future installation.

PART 3 - EXECUTION

3.1 INTERCOMMUNICATION SYSTEMS

A. Installation:

1. The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable emergency communications system.

B. Tamper Resistant Substations:

1. The Contractor shall locate emergency call boxes where shown on the drawings. Provide tamper resistant center post torx screws for mounting the emergency call box units to the tower mounts.

PART 4 - SYSTEM PROGRAMMING

4.1 NOT APPLICABLE

PART 5 - TESTING AND ACCEPTANCE

5.1 REFER TO 280500 PART 5

END OF SECTION 275100

SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The electronic security system (ESS) shall be provided and installed in accordance with the drawings, specifications, and referenced publications.
- B. The Contractor shall perform all work, provide products, systems integration, engineering, and design work required for the project in order to ensure complete and fully operational systems and proper installation of equipment. The Contractor shall provide calculations and analysis to support design and engineering decisions as specified in submittals. The Contractor shall provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. The Contractor shall secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; the Contractor will comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.
- C. The Contractor shall provide an ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to: access control, video surveillance and assessment, video recording and storage, and intercommunication system. End-User training shall be provided as part of the Security Contractors scope. End-User training shall include familiarization, basic system operations and credential production. The Security Contractor shall provide necessary maintenance and trouble shooting manuals as well as submittals as identified herein. The work shall include the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.
- D. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under "Emergency Service". The Contractor shall guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Requirements of Section 5, Acceptance Testing shall take precedence over Division 01 System Acceptance requirements.
- B. Safety Systems: This Division shall apply to Common Work Results for "Electronic Security" only. When applicable, Common Work Results for "Safety" shall precede this division.

- C. Security Management System: This Division (280500 - Electronic Security) shall be used as a base document for electronic security systems. The following sections shall be used in conjunction to provide a complete and fully integrated security management system.
1. 280513 – Conductors and Cables
 2. 281300 – Access Control
 3. 282300 – Video Surveillance
 4. Supplements: The following supplements shall be considered a part of the above referenced Divisions:
 - a. 260500.01.01 – Common Work Results for Electrical – Electronic Security Supplement
 - b. 275100 – Distributed Audio-Video Communication, Security Supplement
- D. Related Sections include the following:
1. Division 01 Section for general requirements
 2. Division 08 Section “Door Hardware”

1.3 RELATED DIVISION PROVISIONS

- A. Division 1 Provisions:
1. Comply with all applicable requirements including bonding, submittals, testing, and site safety.
- B. Division 8 Provisions:
1. The Division 8 Contractor at locations shown on the drawings shall provide all door hardware as shown in the door schedule. Door schedule shall detail all necessary components to interface with the security management system. The Security Contractor shall provide all connections between power supplies and the locking equipment.
- C. Division 26 Provisions:
1. Dedicated Electrical Power (120 VAC) circuits shall be provided by the contractor as required to provide full system functionality. Dedicated electrical power circuits shall be derived from sources provided with emergency backup power. All data transmission and communications devices shall be on uninterrupted power supplies that provide continuous power for a minimum of (8) eight hours. The Contractor shall provide, terminate, and test all system connections.
 2. Contractor shall provide conduit and raceways required by the security systems. Security conduits shall be labeled with blue marking band or blue paint every 30'. Security junction box covers shall be painted with paint manufactured by Benjamin Moore #791, Duron 5085A (Americana) or approved equal.

1.4 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic design only. We intend all publications to be the most current editions but where otherwise noted.

1. American National Standards Institute (ANSI)
 - a. ANSI C2 (1990; TIA 90-2; Errata); National Electrical Safety Code
 - b. ANSI C39.1 (1981; R 1992); Requirements for Electrical Analog Indicating Instruments
 - c. ANSI C42.100 (2000); Standard Dictionary of Electrical and Electronics Terms
 - d. ANSI INCITS 154 (1988; R 1999); Office Machines and Supplies - Alphanumeric Machines-Keyboard Arrangement
 - e. ANSI INCITS 92 (1980; R 2003); Data Encryption Algorithm
 - f. ANSI X3.154 (1988); office machine and supply alphanumeric machine keyboard arrangement.
 - g. ANSI X3.64 (1990); Additional Controls for Use by American National Standard Code for ANSI C2(1993); National Electrical Safety Code Information Exchange
 - h. ANSI X3.92 (1988); Data Encryption Standard
 - i. Alphanumeric Machines/Keyboard Arrangement
 - j. ANSI X9.52 (1998); Triple Data Encryption Alogarithm Modes of Operation
 - k. ANSI/TIA/EIA-568-A Commercial Building Telecommunications Cabling Standard (October 1995 or newer).
 - l. ANS1/TIA/EIA-569 Commercial Building Standard for Telecommunications Pathways and Spaces (October 1990 or newer).
 - m. ANSI/EIA/TIA-570 Residential and Light Commercial Telecommunications Wiring Standard (June 1991 or newer).
 - n. ANSI/TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings (February 1993 or newer).
 - o. ANSI-J-STD-607-A (2002); Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
 - p. ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications (August 1994 or newer).
2. ASTM International (ASTM)
 - a. ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - b. ASTM B 3 (2001) Standard Specification for Soft or Annealed Copper Wire
 - c. ASTM B 32 (2004) Solder Metal
 - d. ASTM C 1107 (2007) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 - e. ASTM D 709 (2001) Laminated Thermosetting Materials
 - f. ASTM E 84 (2007) Standard Test Method for Surface Burning Characteristics of Building Materials
3. Consumer Electronics Association (CEA)
 - a. CEA 170 (1957); Electrical Performance Standards - Monochrome Television Studio Facilities
 - b. CEA-310-E (2005); Racks, Panels, and Associated Equipment
 - c. CEA-330 (2004); Electrical Performance Standards for Closed Circuit Television Camera 525/60

- d. CEA-375-A (2004); Direct View Monochrome Closed Circuit Television Monitors 525/60 Interlaced 2:1
4. Electronic Industries Association (EIA)
 - a. EIA 170 (1957); Electrical Performance Standards
 - b. EIA 232-E (1991); Interface Between Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary data Exchange
 - c. EIA 310-C (1982); Racks, Panels and Associated Equipment
 - d. EIA 330 (1968); Electrical Performance Standards for Closed Circuit Television Camera 525/60 Interlaced 2:1
 - e. EIA 375-A (1974) Electrical Performance Standards – direct view CCTV Monitors
 - f. EIA 445 (1980); Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices
 - g. EIA/TIA-455-3A FOTP-3 Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components
 - h. EIA/TIA-455-B Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components
 - i.
5. Institute of Electrical and Electronics Engineers (IEEE)
 - a. IEEE Std 81 (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
 - b. IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms
 - c. IEEE Std 142 (1991; Err 2006) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book (Color Book Series)
 - d. IEEE Std. 503 (1978) Measurement and Characterization of Diode-Type Cameras.
 - e. IEEE C2 (2005) National Electrical Safety Code
 - f. IEEE C62.41 (1991; R 1995) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
6. International Organization for Standardization (ISO)
 - a. ISO 7810 (2003) Identification Cards – Physical Characteristics
 - b. ISO 7811-1 (2002) Identification Cards – Recording Technique - Part 1: Embossing
 - c. ISO 7811-2 (2001) Identification Cards – Recording Technique - Part 2: Magnetic Stripe - Low Coercivity
 - d. ISO/IEC 7811-5 (1995) Identification Cards – Recording Technique - Part 5: Location of Read-Write Magnetic Track - Track 3
7. International Telecommunications Union (ITU)
 - a. ITU V.34 (1998) Data Communication Over the Telephone Network: A Modem Operating at Data Signaling Rates of up to 33,600 bits for use on the General Switched Telephone Network and on Leased Point-to-Point Two-Wire Telephone Type Circuits
 - b. ITU V.42 (CORR 1 2003) Data Communications Over the Telephone Network: Error-Correcting Procedures for DCEs Using Asynchronous-to-Synchronous Conversion

- c. ITU V.42 bis (1990) Data Communication over the Telephone Network: Data Compression Procedures for Data Circuit Terminating Equipment (DCE) Using Error Correction Procedures
 - d. ITU V.92 (AMD 2001, AMD 2002 and CORR 2003) Enhancements to Recommendation V.90 Series: V, with Amendments 1 and 2
8. National Electrical Manufacturers Association (NEMA)
 - a. NEMA 250 (2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
 - b. NEMA ICS 1 (2000; R 2005) Industrial Control and Systems: General Requirements
 - c. NEMA ICS 2 (2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
 - d. NEMA ICS 6 (1993; R 2006) Industrial Control and Systems: Enclosures
9. National Fire Protection Association (NFPA)
 - a. NFPA 70 (2005; TIA 2005); National Electrical Code
 - b. NFPA 72 (2007);- National Fire Alarm Code.
 - c. NFPA 101 Chapter 5 (1999); Life Safety Code
 - d. NFPA 262 (2007); Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
 - e. NFPA 730 (2006 or Newer); Guide for Premises Security
 - f. NFPA 731 (2006 or Newer); Standard for the Installation of Electronic Premises Security Systems
10. Security Industry Association
 - a. SIA BIO-01(2000 or Newer); Biometric Standard, Vocabulary for Testing
 - b. SIA CP-01 (2000 or Newer); Control Panel Standard
 - c. SIA DC-01 (1988 or Newer); Digital Communications Technical Report - Receiver-to- Computer Interface Protocol
 - d. SIA DC-03 (1990 or Newer); Digital Communications Standard - "SIA Format" Protocol - for Alarm System Communications
 - e. SIA DC-07 (2001); SIA Digital Communications Standard - Receiver-to-Computer Interface Protocol (Type 2) - for Central Station Equipment Communications
11. Society of Motion Picture and Television Engineers (SMPTE)
 - a. SMPTE 170M (2004) Television - Composite Analog Video Signal - NTSC for Studio Applications
12. Telecommunication Industry Association (TIA)
 - a. TIA-232-F (1997; R 2002); Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
 - b. ANSI/TIA/EIA 492AAAA-A (2002); Detail Specification for 62.5µm Core Diameter / 125µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers.
 - c. ANSI/TIA/EIA-526-14-A – Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant OFSTP-14A

- d. ANSI/TIA/EIA-568-B.1 (2001 Addendums 2001, 2003, 2003, 2003, 2004, 2007) Commercial Building Telecommunications Cabling Standard – Part 1: General Requirements
 - e. ANSI/TIA/EIA-568-B.2 (2002); Commercial Building Telecommunications Cabling Standard. Part 2: Balanced Twisted-Pair Cabling Components
 - f. ANSI/TIA/EIA-568-B.3 (2002); Commercial Building Telecommunications Cabling Standard. Part 3: Optical Fiber Cabling Components Standard
 - g. ANSI/TIA/EIA-569-B (2004); Commercial Building Standard for Telecommunications Pathways and Spaces
 - h. ANSI/TIA/EIA-598-B (2001); Optical Fiber Cable Color Coding
 - i. ANSI/TIA/EIA-604-2 (2002); Fiber Optic Connector Intermateability ST-Style Connectors
 - j. ANSI/TIA/EIA-604-3-A (2002); Fiber Optic Connector Intermateability SC-Style Connectors
 - k. ANSI/TIA/EIA-604-12(2002); FOCIS 3A Fiber Optic Connector Intermateability Standard
 - l. ANSI/TIA/EIA-606-A (2002); Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 - m. ANSI/TIA/EIA TSB-67 (1995 or Newer); Transmission Performance Specifications for Field Testing of Unshielded Twisted- Pair (UTP) Cabling Systems - Draft
 - n. ANSI/T1A/E1A TSB-72 (1995 or Newer); Centralized Optical Fiber Cabling Guidelines - Draft.
13. Code of Federal Regulations
- a. 21 CFR 1020 (2006); Performance Standards for Ionizing Radiation Emitting Products
 - b. 14 CFR 108.17 & 129.26 (2006);U.S. Federal Aviation Standards
 - c. 29 CFR 1910.7 (2004); Definition and requirements for a nationally recognized testing
 - d. 47 CFR 15 (2007); Radio Frequency Devices
 - e. 47 CFR 68 (2006); Connection of Terminal Equipment to the Telephone Network
14. Underwriters Laboratories (UL) - The Contractor shall provide evidence of system compliance and shall clearly indicate any specific departures from the UL Listed configuration for the system provided.
- a. UL 6 (2004); Rigid Metal Conduit
 - b. UL 50 (1995); Electrical Cabinets and Boxes
 - c. UL 83 (2003); Thermoplastic-Insulated Wires and Cables
 - d. UL 294 (1999; Rev thru Aug 2005) Access Control System Units
 - e. UL 444 (2002); Communications Cables
 - f. UL 464 (2003; Rev thru Oct 2003) Audible Signal Appliances
 - g. UL 467 (2004); Standard for Grounding and Bonding Equipment
 - h. UL 497B (2004); Protectors for Data Communication and Fire Alarm Circuits
 - i. UL 609 (1996; Rev thru Mar 2005) Local Burglar Alarm Units and Systems
 - j. UL 634 (2000); Connectors and Switches for Use with Burglar-Alarm Systems
 - k. UL 636 (1996; Rev thru Mar 2001) Holdup Alarm Units and Systems
 - l. UL 639 (1997; Rev thru Sep 2002) Intrusion Detection Units
 - m. UL 681 (1999; Rev thru Jan 2001) Installation and Classification of Burglar and Holdup Alarm Systems
 - n. UL 796 (2006); Printed-Wiring Boards
 - o. UL 797 (2004); Electrical Metallic Tubing -- Steel

- p. UL 827 (1996; Rev thru Apr 1999) Central Station Alarm Services
 - q. UL 910 (1998); UL 910 UL Standard for Safety Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
 - r. UL 969 (1995); Standard for Marking and Labeling Systems
 - s. UL 972 (2006); Burglary Resisting Glazing Material
 - t. UL 1037 (1999; Rev thru Nov 2004); Standard for Safety Antitheft Alarms and Devices
 - u. UL 1076 (1995; Rev thru Mar 2005); Standard for Safety Proprietary Burglar Alarm Units and Systems
 - v. UL 1410 (1991); Television Receivers and High Voltage Video Products
 - w. UL 1424 (2005); Standard for Cables for Power-Limited Fire-Alarm Circuits
 - x. UL 1492 (1996; R May 2004); Safety Audio-Video Products and Accessories
 - y. UL 1581 (2001); Reference Standard for Electrical Wires, Cables, and Flexible Cords
 - z. UL 1610 (1998; Rev thru Aug 2005); Central-Station Burglar-Alarm Units
 - aa. UL 1635 (1996; Rev thru Aug 2005); Digital Alarm Communicator System Units
 - bb. UL 1638 (2001; Rev thru Nov 2003); Visual Signaling Appliances - Private Mode Emergency and General Utility Signaling
 - cc. UL 1655 (1997); Standard for Community-Antenna Television Cables
 - dd. UL 1660 (2004); Liquid-Tight Flexible Nonmetallic Conduit
 - ee. UL 1666 (2007); Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
 - ff. UL 1981 (1994; Rev. 1999); Central Station Automation Systems
 - gg. UL 2050 (2003; 4th Edition); National Industrial Security Systems
 - hh. UL 2196 (2007); Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
15. Federal Communication Commission (FCC)
- a. FCC Part 15 (July 1986) rules and regulations; Radio Frequency Devices.
16. Federal Specifications (FS)
- a. WC-586 (Revised) conduit outlet boxes, bodies, and entrance caps electrical; cast metal.

1.5 SUMMARY

A. Section Includes:

1. Description of Work for Electronic Security Systems
2. Electronic security equipment coordination with relating Divisions
3. Submittal Requirements for Electronic Security
4. Miscellaneous Supporting equipment and materials for Electronic Security
5. Electronic security installation requirements.

B. This Section includes a security access control system, a component of the GE Facility Commander WNX v7.5 Security Management Systems consisting of a server, one or more

networked workstation computers, operating system and application software, and field-installed security equipment. The SMS shall reside on the college's dedicated Montgomery College Facilities Network (MC F-Net). The security access system shall have the following:

1. Access Control:
 - a. Regulating access through doors, gates, and others access points specified in drawing documents.
 - b. Credential cards and readers.
 - c. Monitoring of field-installed devices.
 - d. Reporting.
2. Security:
 - a. Video and camera control.
 - b. Emergency communications systems.

1.6 DEFINITIONS

- A. ACAM: Access Control and Alarm Monitoring
- B. AGC: Automatic Gain Control.
- C. B/W: Black and White.
- D. BICSI: Building Industry Consulting Service International
- E. CCD: Charge-coupled device.
- F. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.
- G. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- H. CPU: Central processing unit.
- I. Credential: Data assigned to an entity and used to identify that entity.
- J. DGP: Data Gathering Panel
- K. DVR: Digital Video Recorder
- L. EMI: Electromagnetic interference.
- M. EMT: Electric Metallic Tubing
- N. ESS: Electronic Security System
- O. File Server: A PC in a network that stores the programs and data files shared by users.
- P. GFI: Ground fault interrupter.
- Q. IDC: Insulation displacement connector.

- R. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- S. I/O: Input/Output.
- T. MCF-Net: Montgomery College Facilities Network
- U. NIC: Network Intelligent Controller
- V. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- W. LAN: Local area network.
- X. LCD: Liquid-crystal display.
- Y. LED: Light-emitting diode.
- Z. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- AA. LOD: Level of Detail
- BB. LOE: Level of Effort
- CC. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- DD. M-JPEG: Motion – Joint Photographic Experts Group.
- EE. MPEG: Moving picture experts group.
- FF. NEC: National Electric Code
- GG. NEMA: National Electrical Manufacturers Association
- HH. NFPA: National Fire Protection Association
- II. NTSC: National Television System Committee.
- JJ. NRTL: Nationally Recognized Testing Laboratory.
- KK. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- LL. OSHM: Office of Safety, Health and Environmental Management
- MM. OTDR: Optical Time Domain Reflectometer
- NN. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.

- OO. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).
- PP. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.
- QQ. PIR: Passive infrared.
- RR. RCDD: Registered Communications Distribution Designer.
- SS. RF: Radio frequency.
- TT. RFI: Radio-frequency interference.
- UU. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.
- VV. ROM: Read-only memory. ROM data are maintained through losses of power.
- WW. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- XX. RS-485: An TIA/EIA standard for multipoint communications.
- YY. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- ZZ. SMS: Security Management System – A SMS is a software that incorporates multiple security subsystems (e.g., access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- AAA. Standard Intruder: A person who weighs 45 kg (100 lb.) or less and whose height is 1525 mm (60 in) or less; dressed in a long-sleeved shirt, slacks, and shoes.
- BBB. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.
- CCC. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- DDD. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- EEE. TWAIN: (Technology without an Interesting Name.) A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.
- FFF. UPS: Uninterruptible Power Supply
- GGG. UTP: Unshielded Twisted Pair
- HHH. VPN: Virtual Private Network
- III. WAN: Wide Area Network.

JJJ. WAV: The digital audio format used in Microsoft Windows.

KKK. Windows: Operating system by Microsoft Corporation.

LLL. Workstation: A PC with software that is configured for specific limited security system functions.

MMM.WYSIWYG: (What You See Is What You Get.) Text and graphics appear on the screen the same as they will print.

1.7 GENERAL ARRANGEMENT OF CONTRACT DOCUMENTS

- A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the Contractor shall submit details of such departures or conflicts in writing to the owner or owner's representative for his or her comment and/or approval before initiating work.
- B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

1.8 SUBMITTALS

- A. General: Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breadth or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. Additional general provisions are as follows:
 - 1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to 01000 Specifications - Design Submittal Procedures, which outline basic submittal requirements and coordination. 01000 Specifications shall be used in conjunction with this section.
 - 2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
 - 3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.

4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrows or highlighting. Provide space for Owner and Consultant review stamps.
5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with Montgomery Community College CAD Standards. **FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. THE CONTRACTOR SHALL NOT REPRODUCE CONTRACT DOCUMENTS OR COPY STANDARD INFORMATION AS THE BASIS OF THE TECHNICAL DATA DRAWINGS.** If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Owner for approval before the initiation of work.
6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
 - a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
 - 1) Where two (2) or more binders are necessary to accommodate data; correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.
 - 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
 - b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
 - c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
 - d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
 - e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
 - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
 - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
 - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.

- f. Manual Content: In each manual include information specified in the individual Specification section, and the following information for each major component of building equipment and controls:
- 1) General system or equipment description.
 - 2) Design factors and assumptions.
 - 3) Copies of applicable Shop Drawings and Product Data.
 - 4) System or equipment identification including: manufacturer, model and serial numbers of each component, operating instructions, emergency instructions, wiring diagrams, inspection and test procedures, maintenance procedures and schedules, precautions against improper use and maintenance, repair instructions, sources of required maintenance materials and related services, and a manual index.
- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.
- h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.
- i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
- j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
- k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
- l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.
- m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures.

Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.

- n. Calculations: Provide a section for circuit and panel calculations.
 - o. Certifications: Provide section for Contractor's manufacturer certifications.
7. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
8. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.
- B. Group I Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. The data package shall include the following:
- 1. Section I - Drawings:
 - a. General – Drawings shall conform to Montgomery Community College CAD Standards. All text associated with security details shall be 1/8" tall for AutoCAD™ drawings.
 - b. Cover Sheet – Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
 - c. General Information Sheets – General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Project Phasing, and Sheet Index.
 - d. Floor Plans – Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall AutoCAD™ drawings. Floor plans shall identify the following:
 - 1) security devices by symbol,
 - 2) wire & cable types and counts
 - 3) conduit sizing and routing
 - 4) conduit riser systems
 - 5) device and area detail call outs
 - e. Architectural details – Architectural details shall be produced for each device mounting type.
 - f. Riser Diagrams – Contractor shall provide a riser diagram indicating riser architecture and distribution of the SMS throughout the facility (or area in scope).
 - g. Block Diagrams – Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., electronic entry control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.
 - h. Interconnection Diagrams – Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule.

Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.

- i. Security Details –
 - 1) Panel Assembly Detail – Provide a detail for each panel assembly type.
 - 2) Device Mounting Details – Provide detailed mounting drawing for each security device (electronic entry control, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing. Each detail shall incorporate project architectural details.
 - 3) Details of connections to power supplies and grounding
 - 4) Details of surge protection device installation
 - 5) Sensor detection patterns – Each system sensor shall have associated detection patterns.
 - 6) Equipment Rack Detail – For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BICSI wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal ladder rack system.
 - 7) Equipment Room – Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.
- j. Electrical Panel Schedule – Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.
- k. Door Schedule – A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:
 - 1) Item Number
 - 2) Door Number (Derived from A/E Drawings)
 - 3) Floor Plan Sheet Number
 - 4) Standard Detail Number
 - 5) Door Description (Location/Room Name)
 - 6) Data Gathering Panel Input Number
 - 7) Door Position or Monitoring Device Type & Model Number
 - 8) Lock Type, Model Number & Power Input/Draw (standby/active)
 - 9) Card Reader Type & Model Number
 - 10) Shunting Device Type & Model Number
 - 11) Sounder Type & Model Number
 - 12) Manufacturer
 - 13) Misc. devices as required
 - a) Delayed Egress Type & Model Number
 - b) Intercom
 - c) Camera
 - d) Electric Transfer Hinge
 - e) Electric Pass-through device

- 14) Remarks column indicating special notes or door configurations
- I. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the Owner to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:
 - 1) Item Number
 - 2) Camera Number
 - 3) Naming Conventions
 - 4) Description of Camera Coverage
 - 5) Camera Location
 - 6) Floor Plan Sheet Number
 - 7) Camera Type
 - 8) Mounting Type
 - 9) Standard Detail Reference
 - 10) Power Input & Draw
 - 11) Power Panel Location
 - 12) Remarks Column for Camera
2. Section II – Network Intelligent Controller Documentation Package
 - a. Not Required
3. Section III - Construction Mock-up: In areas with exposed EMT/Conduit Raceways, contractor shall conceal raceway as much as practical and unobtrusively. In addition, historic significance must be considered to determine installation means and methods for approval by the owner.
4. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
5. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
 - a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.
 - b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.
 - c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.

6. Section VI – Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.11 A "Contractor Qualifications".

C. Group II Technical Data Package

1. Not required.

D. Group III Technical Data Package

1. Not required.

E. Group IV Technical Data Package

1. Training Documentation

- a. Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for technicians and administrative personnel. General information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided. See "Familiarization Training" for specific training requirements.

2. System Configuration and Data Entry:

- a. The contractor is responsible for providing all system configuration for the SMS and subsystems. All data entry shall be performed by Montgomery. The Contractor is responsible for participating in all meetings with the Owner to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated into the project schedule as a milestone task. The Contractor shall be responsible for all system configurations. The contractor shall configure the following components:

- 1) Access control system components
- 2) Video surveillance, control and recording systems

- a) Contractor shall document the MAC Address and Manufacturer IP Address for all IP cameras. The Contractor shall turn this documentation over to the college for system programming.

- 3) Intercom systems components
- 4) All other security subsystems shown in the contract documents

- b. The College is responsible for compiling the card access database for the College's employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.

- c. Refer to Part 4 for system programming requirements and planning guidelines.

3. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and all other pertinent information in the

Contractor's possession to complete the graphics. The Contractor shall identify and request from the Owner, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 8" x 10" of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Owner for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.

- F. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Owner as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Two (2) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.
1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
 2. Equipment Manual: A manual describing all equipment furnished including:
 - a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.
 3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
 - a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
 4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
 - a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.

5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Owner a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by Montgomery Community College Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
 - a. Equipment and/or system function.
 - b. Operating characteristics.
 - c. Limiting conditions.
 - d. Performance curves.
 - e. Engineering data and test.
 - f. Complete nomenclature and number of replacement parts.
 - g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
 - h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
 - i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.
 - j. Manufacturer equipment and systems maintenance manuals are permissible.
9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the Owner or authorized representative. Master redlines shall be neatly maintained throughout the project and secured in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redlines document to the Owner for review and approval of all changes or modifications to the documents. Each sheet shall have Owner's initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made

to the master redline documents daily. Field drawings shall not be considered "master redlines".

10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the Owner. As with master redlines, Contractor shall maintain record specifications for Owner review and inspection at anytime.
11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the Owner.
12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include, a minimum of the following:
 - a. Certificates received instead of labels on bulk products.
 - b. Testing and qualification of tradesmen. ("Contractor's Qualifications")
 - c. Documented qualification of installation firms.
 - d. Load and performance testing.
 - e. Inspections and certifications.
 - f. Final inspection and correction procedures.
 - g. Project schedule
13. Record Construction Documents (Record As-Built)
 - a. Upon project completion, the Contractor shall submit the project master redlines to the Owner prior to development of Record construction documents. The Owner shall be given a minimum of thirty (30) days to review and determine the adequacy of the master redlines. If the master redlines are found suitable by the Owner, the Owner will initial and date each sheet and turn the redlines over to the contractor for "as-built" development.
 - b. The Contractor shall provide the Owner a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, network intelligent

controller number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the Owner. If, in the opinion of the Owner, any redlined notation that is not legible, shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted "as-builts" shall be in editable formats and the ownership of the drawings shall be fully relinquished to the Montgomery Community College.

- c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the Owner. The Contractor shall organize into bound and labeled sets for the Owner's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 4".

1.9 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic security equipment:
 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 3. To allow right of way for piping and conduit installed at required heights.
 4. Ensure raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate the installation of required supporting discipline devices placement and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate the locations of access panels and doors for electronic security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."."
- E. Contractor shall coordinate as needed with all related Divisions.

1.10 QUALITY ASSURANCE

A. Contractor Qualifications

1. The Contractor or Security Sub-Contractor shall be a licensed Security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (SMS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The Owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the SMS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The Owner reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
2. The Contractor shall provide proof project superintendent is a BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
3. Cable installer must have on staff a BICSI certified Registered Communication Distribution Designer (RCDD). The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

C. Source Limitations: Obtain Central Station, workstations, Controllers, Identifier readers, and all software through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Experience

1. The Contractor shall submit written proof that the following experience requirements are being met.
 - a. Hardware Manufacturer's Experience: All system components shall be produced by manufacturers who have been regularly engaged in the production of electronic security system components of the types to be installed for at least five (5) years.

- b. Software Manufacturer's Experience: All system and application software shall be produced by manufacturers who have been regularly engaged in the production of electronic security system and application software of similar type and complexity as the specified system for at least five (5) years. Experience shall include museum or similar experience in cultural facilities and cultural storage and handling facilities.
- c. System Installer Experience: The system shall be installed by a Contractor who has been regularly engaged in the installation of electronic security system equipment of similar type and complexity.

F. Manufacturers' Representatives

- 1. The Contractor shall retain a manufacturers' technical representative or technician to consult on equipment selection, installation, testing, and training personnel. The manufacturers' technical representative or technician shall be thoroughly experienced in the installation and operation of the system being provided under this contract with no less than five (5) continuous years of technical experience.

G. Material & Workmanship

- 1. Unless otherwise specifically provided under this contract, all equipment, material and articles to be incorporated in the work shall be new and of the most suitable grade for the purposes intended. References to any equipment, material, article or patented process, by trade name, make or catalog number shall be regarded as establishing a standard of performance and quality, and shall not be construed as limiting competition. The Contractor may, at his or her option, use any equipment, material, article, or process which, in the judgment of the Owner, is equivalent to or better than that specified. When required by this contract or when called for by the Owner, the Contractor shall furnish the name of the manufacturer, model number, and other identifying data and information that reflects the performance, capacity, nature and rating of the electrical, mechanical, and other equipment that the Contractor contemplates incorporating in the work to the Owner for approval. When so directed, the Contractor shall submit samples for approval at the Contractor's expense. Equipment, materials and articles installed or used without the required approval shall be at the Contractor's risk of rejection. Warranties of all work and installed products shall be according to the Contract General Provisions. The Contractor shall be responsible for assuring the compatibility of new systems with Montgomery Community College's pre-existing card format and GE Security Management Systems with Network Host/Node Capability.

1.11 MAINTENANCE & SERVICE

- A. General Requirements: The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.
- B. Description of Work: The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system

sensors, access control equipment, facility interface, signal transmission equipment, and video equipment.

- C. Personnel: Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Owner shall be advised in writing of the name of the designated service representative, and of any change in personnel. The Owner shall be provided copies of system manufacturer certification for the designated service representative.
- D. Schedule of Work: The work shall be performed during regular working hours, Monday through Friday, excluding holidays. These inspections shall include:
1. The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
 - a. Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
 - b. Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.
- E. Emergency Service: The Owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. Montgomery Community College shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
1. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from arrival on site. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility at increased risk.
 2. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.
- F. Operation: Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.
- G. Work Request: The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.
- H. System Modifications: The Contractor shall make any recommendations for system modification in writing to the Owner. No system modifications, including operating parameters

and control settings, shall be made without prior written approval from the Owner. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

- I. Software: The Contractor shall provide all software updates when approved by Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

1.12 SYSTEM DESCRIPTION

- A. Security devices and hardware provided under this project shall be integrated with the Owner's existing Security Management System. The existing SMS resides on a server located in the main MDF room of the Computer Science building on the Montgomery College, Rockville MD, campus. Communications between the devices/hardware of the project site and the SMS server shall be via the Owner's proprietary MC F-Network. Network Intelligent Controllers shall be terminated on MC F-Net switches, where they shall communicate directly with the SMS server.

1.13 PERFORMANCE REQUIREMENTS

- A. The SMS shall use a single database for access-control and credential-creation functions.
- B. Distributed Processing: System shall be a fully distributed processing system so information, including time, date, valid codes, access levels, and similar data is downloaded to Controllers so each Controller makes access-control decisions for that Location. Do not use intermediate Controllers for access control. If communications to Central Station are lost, all Controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the Central Station.
- C. Cardholder records - 250,000 maximum.
- D. Card readers - 2048 maximum per server.
- E. Alarm input points - 32,768 maximum per server.
- F. Relay outputs - 20,000 maximum.
- G. Client workstations - 64.
- H. Operator passwords – 512.
- I. Interface with up to 512 NICs per server.

- J. Up to 2048 security areas (controlled areas) per server.
- K. Time intervals – 255.
- L. 255 time schedules.
- M. 128 user-defined cardholder fields and 128 visitor fields.
- N. 128 data fields per cardholder.
- O. 16 alarm priorities.
- P. 32 user-defined alarm categories.
- Q. 512 action/instruction text messages.
- R. Global and local, hard, soft and timed anti-passback/anti-tailgate capability.
- S. Configurable alarm-to-relay linking, downloaded to field controllers for local operation.
- T. Configurable automatic time zone controlled commands, downloaded to the field controller for automatic local operation.
- U. Configurable automatic, time controlled report generation and/or disk backup commands.
- V. Visitor management and badging utility.
- W. History/audit trail.
- X. Ability to respond to access requests/alarm conditions before and during download to networked intelligent controllers.
- Y. Automatic card activation and deactivation.
- Z. Global and local alarm masking by operator or cardholder.
- AA. Access activity analysis by card reader.
- BB. High integrity dial-up capability to support access control panels and readers at remotely located sites via dial-up communication over public switched telephone network, and to download database and upload transaction history based on operator commands. This feature shall provide the capability to segregate dial-up modem ports for Alarm Only reception, and for uploading and downloading database and transaction history information, so that even if all the upload/download ports are in use, the remote dial-up NICs can establish communication through Alarm Only modem ports to annunciate alarm conditions. The memory systems and functionality of the remote NICs shall be such that data corruption during database download, or interrupted communications during download shall not interfere with the ability of the remote NICs to continue to operate normally using database information previously downloaded to it.
- CC. Capability to define within the system up to 127 variable card formats and have each card reader able to read three separate formats.
- DD. Integrated photo-badging system incorporating a complete multi-layer, drag and drop, WYSIWYG, database keyed badge design facility, editor, and drawing package. The system

must be capable of allowing enrollment facilities at any designated workstation, and displaying photo-images of cardholders at any workstation on an individual system.

- EE. The system shall be capable of interfacing through NICs to keypads or card reader/keypad combinations with LCD displays allowing the system to operate as a proprietary burglar alarm system for designated security areas. The system shall provide delayed alarm reporting and masking facilities using these devices so that arming and disarming of security areas is delayed for a preset period. This will allow personnel entering an area to have the opportunity to disarm (mask) the alarm reporting facility by entering a code into the keypad, entering a card or both. During this entry delay period the LCD/keypad/card reader device shall emit an audible tone until the area is disarmed (masked). The system will allow the user to arm (unmask) the system before leaving the designated area, by entering data on the keypad, using a card or both, and the display shall provide information concerning the status of any unsecured alarm points in the area. Once the security area has been armed, the device will emit an audible tone for a predetermined time, and delay reporting alarm status for this same time to allow the occupant time to exit the secured area.
- FF. The system shall provide a direct RS-232 Data interface for control of CCTV Sub-systems utilizing designated switching devices.
- GG. The System shall provide local elevator cab control software as a standard feature.
- HH. Optional host upload capability to import data from external computer systems and databases.
- II. Optional monitor point verification program supporting the ability to walk test alarmed areas and create reports of the results of the test during on-line operation.
- JJ. Optional area loading capability.
- KK. Optional two man rule functionality using single card reader, dual card reader or combination of card reader and workstation operator.]
- LL. Optional radio paging capability to report alphanumerically alarm conditions to designated security personnel through a radio pager interface with the Visiplex V3100 paging system..
- MM. Capability to support multiple –Variable card formats].
- NN. Optional Multiple Server control (Enterprise) capability to allow multiple independent ACAM systems to be linked by local or wide area networks or T1 links, to allow sharing of database information and password protected control of each independent system from any server or workstation on any of the systems on the network. Must include capability to route alarm information between systems based on operator command.
- OO. Optional partitioned database capabilities to provided control and access to specific card records, security areas, alarm points and relay points based on group assignments.
- PP. Optional guard tour control and monitoring] of at least 64 guard tours.
- QQ. Capability to support multiple site and facility codes at card readers.
- RR. Capability to support temporary badge operation.
- SS. Capability to support biometric access control and verification readers.
- TT. Capability to support TDES encrypted communications between ACAM servers and NICs.

- UU. Capability to support the requirements of DOD SCIF areas (Group Protected Areas).
- VV. Capability to mask and unmask security areas globally from a single card reader/keypad with LCD display prompts.
- WW. System Network Requirements:
1. Interconnect system components and provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
 2. Communication shall not require operator initiation or response, and shall return to normal after partial or total network interruption such as power loss or transient upset.
 3. System shall automatically annunciate communication failures to the operator and identify the communication link that has experienced a partial or total failure.
 4. Communications Controller may be used as an interface between the Central Station display systems and the field device network. Communications Controller shall provide functions required to attain the specified network communications performance.
- XX. Central Station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central Station shall control system networks to interconnect all system components, including workstations and field-installed Controllers.
- YY. Field equipment shall include Controllers, sensors, and controls. Controllers shall serve as an interface between the Central Station and sensors and controls. Data exchange between the Central Station and the Controllers shall include down-line transmission of commands, software, and databases to Controllers. The up-line data exchange from the Controller to the Central Station shall include status data such as intrusion alarms, status reports, and entry-control records. Controllers are classified as alarm-annunciation or entry-control type.
- ZZ. System Response to Alarms: Field device network shall provide a system end-to-end response time of one (1) second or less for every device connected to the system. Alarms shall be annunciated at the Central Station within 1 second of the alarm occurring at a Controller or device controlled by a local Controller, and within 100 ms if the alarm occurs at the Central Station. Alarm and status changes shall be displayed within 100 ms after receipt of data by the Central Station. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within five (5) seconds of alarm receipt at the security console. This response time shall be maintained during system heavy load.
- AAA. False Alarm Reduction: The design of Central Station and Controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.
- BBB. Error Detection: A cyclic code error detection method shall be used between Controllers and the Central Station, which shall detect single- and double-bit errors, burst errors of eight (8) bits or less, and at least 99 percent of all other multi-bit and burst error conditions. Interactive or product error detection codes alone will not be acceptable. A message shall be in error if one bit is received incorrectly. System shall retransmit messages with detected errors. A two-digit decimal number shall be operator assignable to each communication link representing the number of retransmission attempts. When the number of consecutive retransmission attempts equals the assigned quantity, the Central Station shall print a communication failure alarm message. System shall monitor the frequency of data transmission failure for display and logging.

CCC. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.

DDD. Door Hardware Interface: Coordinate with Division 08 Sections that specify door hardware required to be monitored or controlled by the security access system. The Controllers in this Section shall have electrical characteristics which match the signal and power requirements of door hardware. Integrate door hardware specified in Division 08 Sections to function with the controls and PC-based software and hardware in this Section.

1.14 DELIVERY, STORAGE, & HANDLING

A. Central Station, Workstations, and Controllers:

1. Store in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 10 to 30 deg C (50 to 85 deg F), and not more than 80 percent relative humidity, non-condensing.
2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
3. Mark packing list with designations which have been assigned to materials and equipment for recording in the system labeling schedules generated by cable and asset management system specified in Part 2.
4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.15 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient conditions of 16 to 30 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent, non-condensing.
2. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.
3. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 4x enclosures.
4. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick. NEMA 250, Type 4X enclosures.

5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
6. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.
7. Security Environment: Use vandal resistant enclosures in high-risk areas where equipment may be subject to damage.

1.16 EQUIPMENT AND MATERIALS

A. General Equipment Requirements: Equipment and materials furnished shall be new, first grade, standard, current products of the manufacturer, and be suitable for the systems being installed and the intent of the design.

1. Where the words, "or shall be an approved equivalent" or like words are used, it shall mean that materials, devices, or equipment of equivalent or equal quality, function, operation, and appearance shall be furnished upon the approval of the Owner. If the contractor recommends equipment substitution, the contractor is responsible for complete documentation of the reason for the change and is financially liable for the design time expended by the security consultant to research the substitution.
2. Any material, device, or equipment damages before or during installation and before acceptance of the completed system, shall be replaced unless repairs can be made that are acceptable to the Owner. Any such replacement or repairs, including repairs to the finish, shall be made at no cost to the Owner.
3. Equipment and materials shall be properly stored, adequately protected, and carefully handled to prevent damage before and during installation. Equipment and materials shall be handled, stored, and protected according to the manufacturers' recommendations. Equipment provided with a factory finish shall be maintained free of dust, dirt, and foreign matter. Dents, marred finishes, and other damage shall be repaired to its original condition or replaced at no additional cost to the Owner.
4. Parts of the project site are finished spaces, including paint, trim, wall covering, floor treatments, lighting, and building mechanical systems. Therefore, the Contractor shall perform the work specified herein, such that, at the completion of his work, all finished space is restored to the original condition existing prior to the commencement of work. During the course of performing the work specified herein, if the Contractor should encounter any damaged finish in any area where the Contractor's work is to be performed, the Contractor shall notify the Owner in writing prior to performing work in that area. Only after receiving written confirmation that the existing conditions have been documented and authorization has been given to proceed, shall the Contractor proceed with the work in these areas.

B. Extra Materials

1. Furnish extra materials described below which match products installed and are packaged with protective covering for storage and identified with labels describing contents.

- a. Credential card blanks, ready for printing. Include enough credential cards for all personnel to be enrolled at the site plus an extra 500 for use.
- b. Fuses of all kinds, power and electronic, equal to 10 percent of amount installed for each size used, but no fewer than three (3) units.

1.17 ELECTRICAL POWER

- A. Electrical power of 120 Volts Alternating Current (VAC) shall be indicated on the Division 26 drawings. Additional locations requiring primary power required by the security system shall be shown as part of these contract documents. Primary power for the security system shall not be derived from an emergency/back-up power source; therefore the Contractor is responsible for providing battery and UPS back-up power. Alarms shall not be generated as a result of power switching, however, an indication of power switching on (on-line source) shall be provided to the alarm monitor. The Security Contractor shall provide an interface (dry contact closure) between the SMS and the UPS system so the UPS trouble signals and main power fail appear on the SMS operator terminal as alarms.
- B. Failure of any on-line battery shall be detected and reported as a fault condition. Battery backed-up power supplies shall be provided sized for eight (8) hours of operation at actual connected load. Requirements for additional power or locations shall be included with the contract to support equipment and systems offered. The following minimum requirements shall be provided for power sources and equipment.
 1. UNINTERRUPTIBLE POWER SUPPLY (UPS) ON EMERGENCY POWER
 - a. The following 120VAC circuits shall be provided by others. The Security Contractor shall coordinate exact locations with the Electrical Contractor:
 - 1) CCTV Digital Video.

1.18 ENVIRONMENTAL CONDITIONS

- A. Interior, Controlled Environment: All system components except the console equipment installed in interior locations having controlled environments which shall be rated for continuous operation under ambient environmental condition of 0 to 48.9 deg C (32 to 120 deg F) dry bulb and 5 to 100 percent relative humidity, non-condensing.
- B. Interior, Uncontrolled Environment: All system components installed in interior locations with uncontrolled environments shall be rated for continuous operation under ambient environmental condition of -17.8 to 48.9 deg C (0 to 120 deg F) dry bulb and 5 to 100 percent relative humidity, non-condensing.
- C. Exterior Environment: All system components that are installed in locations exposed to weather shall be rated for continuous operation under ambient environmental conditions of -34 to 48.9 deg C (-30 to 120 deg F) dry bulb and 5 to 100 percent relative humidity, condensing. In addition, the system components shall be rated for continuous operation as specified in UL 294 for outdoor use equipment.
- D. Hazardous Environment: All system components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated and installed according to Chapter 5 of the NFPA 70.

- E. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

1.19 LIGHTNING, POWER SURGES, & GROUNDING

- A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lightning and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 3' of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference.
1. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 2. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
 3. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B.
 4. Operating Temperature and Humidity: -40 to 85 deg C (-40 to 185 deg F), 0 to 95 percent relative humidity.
 5. Grounding and Surge Suppression
 - a. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. To ensure the operation of over current devices, such as fuses, circuit breakers, and relays, under ground-fault conditions.
 - b. Security Contractor shall engineer and provide proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards referenced in this document.
 - c. Principal grounding components and features. Include main grounding buses and grounding and bonding connections to service equipment.
 - d. Details of interconnection with other grounding systems. The lightning protection system shall be provided by the Security Contractor.
 - e. Locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
 - f. AC power receptacles are not to be used as a ground reference point.
 - g. Any cable that is shielded shall require a ground in accordance with the best practices of the trade and manufactures installation instructions.
 - h. Protection should be provided at both ends of cabling.
 6. See Part 2 for approved TVSS devices.

1.20 COMPONENT ENCLOSURES

A. Construction of Enclosures

1. Consoles, power supply enclosures, detector control and terminal cabinets, control units, wiring gutters, and other component housings, collectively referred to as enclosures, shall be so formed and assembled as to be sturdy and rigid.
2. Thickness of metal in-cast and sheet metal enclosures of all types shall not be less than those in Tables I and II, UL 611. Sheet steel used in fabrication of enclosures shall be not less than 14 gauge. Consoles shall be 16-gauge.
3. Doors and covers shall be flanged. Enclosures shall not have pre-punched knockouts. Where doors are mounted on hinges with exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent removal. Doors having a latch edge length of less than 609.6 mm (24 in) shall be provided with a single construction core. Where the latch edge of a hinged door is more than 609.6 mm (24 in) or more in length, the door shall be provided with a three-point latching device with construction core; or alternatively with two, one located near each end.
4. Any ventilator openings in enclosures and cabinets shall conform to the requirements of UL 611. Unless otherwise indicated, sheet metal enclosures shall be designed for wall mounting with tip holes slotted. Mounting holes shall be in positions that remain accessible when all major operating components are in place and the door is open, but shall be in accessible when the door is closed.
5. Covers of pull and junction boxes provided to facilitate initial installation of the system shall be held in place by tamper proof Torx Center post security screws. Stenciled or painted labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate the box is part of the Electronic Security System (ESS).

B. Equipment Racks: All vertical equipment racks shall include a forced air-cooling system to be provided by others.

C. Tamper Provisions and Tamper Switches:

1. Enclosures, cabinets, housings, boxes and fittings or every product description having hinged doors or removable covers and which contain circuits, or the integrated security system and its power supplies shall be provided with cover operated, corrosion-resistant tamper switches. In addition, boxes and enclosures in the security closets will be provided with tamper switches. This provision does not include junction boxes, unless the junction boxes contain splices in the security wiring or circuit card assemblies.
2. Tamper switches shall be arranged to initiate an alarm signal that will report to the monitoring station when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. It shall take longer than 1 second to depress or defeat the tamper switch after opening or removing the cover. The enclosure and tamper switch shall function together in such a manner as to prohibit direct line of sign to any internal component before the switch activates.
3. Tamper switches shall be inaccessible until the switch is activated. Have mounting hardware concealed so the location of the switch cannot be observed from the exterior of the enclosure. Be connected to circuits which are under electrical supervision at all

times, irrespective of the protection mode in which the circuit is operating. Be spring-loaded and held in the closed position by the door or cover and be wired so they break the circuit when the door cover is disturbed. Tamper circuits shall be adjustable type screw sets and shall be adjusted by the contractor to eliminate nuisance alarms associated with incorrectly mounted tamper device shall annunciate prior to the enclosure door opening within 1/4 " tolerance. The tamper device or its components shall not be visible or accessible with common tools to bypass when the enclosure is in the secured mode.

4. All enclosures over 12 square inches shall be hinged with an enclosure lock.
5. Control Enclosures: Maintenance/Safety switches on control enclosures, which must be opened to make routing maintenance adjustments to the system and to service the power supplies, shall be push/pull-set automatic reset type.
6. Provide one (1) enclosure tamper switch for each 24 linear inches of enclosure lock side opening evenly spaced.
7. All security screws shall be Torx-Post Security Screws.
8. The contractor shall provide the owner with two (2) torx-post screwdrivers.

1.21 LABELING

- A. All final labeling of security equipment shall be coordinated with the college's finished room numbers as defined in sheet series A200 and A430. Construction room numbers shall be used for final labeling.

1.22 ELECTRONIC COMPONENTS

- A. All electronic components of the system shall be of the solid-state type, mounted on printed circuit boards conforming to UL 796. Boards shall be plug-in, quick-disconnect type. Circuitry shall not be so densely placed as to impede maintenance. All power-dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current-carrying capacity.

1.23 SUBSTITUTE MATERIALS & EQUIPMENT

- A. In addition to this Section the Security Contractor shall also reference Section II, Products and associated divisions. Acceptable manufacturers of products included in this specification are indicated in Part 2.0 Products, Acceptable Manufacturers. Manufacturers not listed must be pre-qualified to bid as indicated herein. The Contractor shall list and identify those materials, devices, or equipment for which he intends a substitution. The Owner shall have final authority on the authorization or refusal of substitutions. If there are no proposed substitutions, a statement in writing from the Contractor shall be submitted to the Owner stating same. In the preparation of a list of substitutions, the following information shall be included, as a minimum:

1. Identity of the material or devices specified for which there is a proposed substitution.

2. Description of the segment of the specification where the material or devices are referenced.
 3. Identity of the proposed substitute by manufacturer, brand name, catalog or model number and the manufacturer's product name.
 4. A technical statement of all operational characteristic expressing equivalence to items to be substituted and comparison, feature-by-feature, between specification requirements and the material or devices called for in the specification; and
 5. Price differential.
- B. Materials Not Listed: Furnish all necessary hardware, software, and supporting equipment required to place the specified major subsystems in full operation. Note that some supporting equipment, materials, and hardware may not be described herein. Depending on the manufacturers selected by the Owner, some equipment, materials and hardware may not be contained in either the Contract Documents or these written specifications, but are required by the manufacturer for complete operation according to the intent of the design and these specifications. In such cases, the Owner shall be given the opportunity to approve the additional equipment, hardware and materials that shall be fully identified in the bid and in the equipment list submittal. The Owner shall be consulted in the event there is any question about which supporting equipment, materials, or hardware is intended to be included.
- C. Response to Specification: The Contractor shall submit a point-by-point statement of compliance with each paragraph of the security specification. The statement of compliance shall list each paragraph by number and indicate "COMPLY" opposite the number for each paragraph where the Contractor fully complies with the specification. Where the proposed system cannot meet the requirements of the paragraph, and does not offer an equivalent solution, the offers shall indicate "DOES NOT COMPLY" opposite the paragraph number. Where the proposed system does not comply with the paragraph as written, but the bidder feels it will accomplish the intent of the paragraph in a manner different from that described, the offers shall indicate "COMPARABLE". The offers shall include a statement fully describing the "comparable" method of satisfying the requirement. Where a full and concise description is not provided, the offered system shall be considered as not complying with the specification. Any submission that does not include a point-by-point statement of compliance, as described above, shall be disqualified. Submittals for products shall be in precise order with the product section of the specification. Submittals not in proper sequence will be rejected.

1.24 LIKE ITEMS

- A. Where two or more items of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer. All equipment provided shall be complete, new, and free of any defects.

1.25 WARRANTY

- A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the Owner certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the

date the Contactor received written notification of final acceptance from the Owner. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the Owner's satisfaction, and at the Contractor's expense. The Contractor shall provide quarterly inspections during the warranty period. The contractor shall provide written documentation to the Owner on conditions and findings of the system and device(s). In addition, the contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty. The warranty period shall be extended until the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of it's failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Network Equipment
 - 1. Owner Furnished
- B. Transient Voltage Surge Suppression
 - 1. DITEK Corporation, or approved equivalent

2.2 WIRELINE DATA TRANSMISSION MEDIA FOR SECURITY SYSTEMS

- A. General: The Contractor shall configure the wire line data transmission media (DTM) as specified and shown. The DTM shall provide communications between individual pieces of field equipment; and between field equipment and security equipment located at the command center located in the Golden Rod Building.
 - 1. Electrical Requirements: The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.
 - 2. Materials and Equipment: All system hardware components shall be produced by manufacturers regularly engaged in the production of wire line communication equipment. Units of the same type of equipment shall be products of a single manufacturer. All material and equipment shall be new and currently in production. Each major component of equipment shall have the manufacturer's name and address, the model, and serial number in a conspicuous place. Equipment located at the security center or a remote control/monitoring station shall be rack mounted as shown. Equipment shall comply with CFR 47 Part 15. Computing devices shall comply with CFR 47 Part 15, Subpart J.
 - 3. Fungus Treatment: System components located in environments conducive to fungus growth shall be completely treated for fungus resistance. Treating materials containing mercury bearing fungicide shall not be used. Treating materials shall not increase the flammability of the component or surface being treated. Treating materials shall not cause skin irritation or other injury to personnel handling it during fabrication, transportation, operation, maintenance, or during the use of the finished items when used for the purpose intended.
 - 4. Soldering: All soldering shall be done in accordance with standard industry practices.
 - 5. Wire Splices: See Section 280513 (Conductors and Cables for Electronic Security).
 - 6. Enclosures: The Contractor shall provide metallic enclosures as needed for equipment not housed in racks or supplied with a housing. The enclosures shall be as specified or shown.
 - a. Interior: Enclosures to house equipment in an interior environment shall meet the requirements of NEMA 250-Type 12.

- b. Exterior: Enclosures to house equipment in an outdoor environment shall meet the requirements of NEMA 250-Type 4. Enclosures exposed to direct sunlight shall be finished with white polyester powder coating and be equipped with a sun shield finished to match the enclosure. Sun shield shall be mounted to protect the top of the enclosure from direct sun and shall extend at least 25.4 mm (1 in) beyond the edges of the enclosure on all sides.
 - c. Corrosion-Resistant: Enclosures to house equipment in a corrosive environment shall meet the requirements of NEMA 250-Type 4X.
 - d. Hazardous Environment: All system electronics to be used in a hazardous environment shall be housed in a metallic enclosure which meets the requirements of paragraph "Hazardous Environment."
 - e. Tamper Provisions: Enclosures, cabinets, housings (other than environmental camera housings), and boxes of every description having hinged doors or removable covers, which contain any part of the DTM or power supplies, shall be provided with cover operated, corrosion-resistant tamper switches, arranged to initiate an alarm signal when the door or cover is moved.
 - 1) Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. Tamper switches shall be inaccessible until the switch is activated; have mounting hardware concealed so the location of the switch cannot be observed from the exterior of the enclosure; be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode; and be wired so they break the circuit when the door or cover is disturbed. Tamper switches on the doors which must be opened to make routine maintenance adjustments to the system and to service the power supplies shall be push/pull-set, automatic reset type.
 - f. Enclosure Covers: Covers of pull and junction boxes provided to facilitate installation of the system need not be provided with tamper switches if they contain no splices or connections and held in place with tamper proof Torx Center post security screws. Provide stenciled labels for each box.
7. Locks and Key-Lock Operated Switches:
- a. All locks required to be installed on system enclosures for maintenance purposes shall be UL listed and approved with manufacturer installed cores or contractor installed construction cores.
 - b. All key-lock-operated switches required to be installed on system components shall be UL listed and approved with manufacturer installed cores or contractor installed construction cores.
 - c. All keys and locks shall be provided in accordance with Montgomery Community College standards. Contractor shall coordinate key and lock provisions with campus locksmiths.
8. System Integration: Security System Communication equipment shall be supplied with all adapters, connectors, terminators, cables, main frames, card cages, power supplies, rack mounts, and appurtenances as needed for a fully functional system.
- B. Equipment: Communications equipment for circuits between the local processor and the central processor unit shall be capable of transmitting data within the error rate specified over the distances shown.

1. Line Drivers: Line drivers shall transmit data at a minimum 9600 bps over the distances as shown.
2. Wire line Cable: Wire line cable shall be insulated solid copper type conforming to the following specifications. A minimum of No. 22 AWG shall be used for all applications or as specified by manufacturer specifications.
 - a. Cable Construction: All cable components shall be able to withstand the environment the cable is installed in for a minimum of 20 years.
 - b. Underground Cable: REA PE-22.
 - c. Interior Cable: Current issue of the NFPA 70, and EIA TIA.
3. Special Test Equipment: The Contractor shall provide all special test equipment, special hardware, software, tools, initialization equipment needed to start or maintain any part of the system and its components. Special test equipment is defined as any test equipment not normally used in an electronics maintenance facility.

2.3 NETWORK EQUIPMENT

- A. All switches, hubs, and routers shall be provided by the Owner. Contractor shall terminate the NIC and NVRs to the Owner's MC F-Net switch.
- B. Ports shall be made available at the MC F-Network PoE switches to terminate Video Surveillance cameras.

2.4 POWER SURGES AND GROUNDING

- A. Transient Voltage Surge Suppression
 1. All cables and conductors extending beyond building perimeter shall be protected against Transient Voltage surges and have Transient Voltage surge suppression protection (TVSS) UL listed in accordance with Standard 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 915 mm (36 in) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:
 - a. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 - b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
 - c. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equivalent.
 - d. Operating Temperature and Humidity: -40 to + 85 deg C (-40 to 185 deg F), and 0 to 95 percent relative humidity, non-condensing.
- B. Intercom Systems

1. Suppressors shall be installed on the AC power at the point of service and shall meet the following criteria:
 - a. UL 1449 Listed
 - b. UL 1449 S.V.R. of 400 Volts or lower
 - c. Diagnostic Indicator Light(s)
 - d. Integrated ground terminating post (where case/chassis ground exists)
 - e. Minimum Surge Current Capacity of 13,000 Amps (8 x 20 μ Sec)
 - f. Ten Year Limited Warranty
 - g. Acceptable Manufacturer: DITEK CORP. DTK 3GTP, DTK-3GTPX, or approved equivalent.

 2. Suppressors shall be installed on all telephone/intercom circuits that enter or leave separate buildings and shall meet the following criteria:
 - a. UL 497A Listed (where applicable)
 - b. UL 497B Listed (horns, strobes, speakers or communication circuits over 300 feet)
 - c. Multi Stage protection design
 - d. Auto-reset over-current protection not to exceed 5 Amps per pair
 - e. Minimum Surge Current of 1000 Amps per pair (8 x 20 μ Sec)
 - f. Ten Year Limited Warranty
 - g. Acceptable Manufacturer: DITEK CORP., or approved equivalent
 - 1) DTK-SL Series
 - 2) DTK-MT_SCP Series
 - 3) DTK-2MHLP/2MHTP Series
 - 4) DTK-LVLP Series
- C. 120 VAC Surge Suppression
1. Shall be Ditek HW Series, or approved equivalent.
 2. Continuous Current: Unlimited (parallel connection)
 3. Max Surge Current: 13,500 Amps
 4. Protection Modes: L - N, L - G, N - G
 5. Warranty: Ten Year Limited Warranty
 6. Dimension: 73.7 x 41.1 x 52.1 mm (2.90 x 1.62 x 2.05 in)
 7. Weight: 2.88 g (0.18 lbs)
 8. Housing: ABS
 9. Other Specifications:
 - a. 120HW
 - 1) Agency Approvals: UL1449, cUL
 - 2) Connection: 110-120VAC
 - 3) MCOV: 130VAC
 - 4) Max Surge Current: 22,500A

- b. 240HW
 - 1) Agency Approvals: N/A
 - 2) Connection: 120/240VAC
 - 3) MCOV: 130/260VAC
 - 4) Max Surge Current: 27,000A

- c. 3W220HW
 - 1) Agency Approvals: N/A
 - 2) Connection: 220-240VAC
 - 3) MCOV: 250VAC
 - 4) Max Surge Current: 13,500A

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 GENERAL

- A. The Contractor shall install all system components and appurtenances in accordance with the manufacturer's instructions, ANSI C2, and furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.
- B. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.
- D. Current Site Conditions: The Contractor shall visit the site and verify site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the COTR in a report as defined in paragraph Group II Technical Data Package. The Contractor shall take no corrective action without written permission from the COTR.

PART 4 - SYSTEM PROGRAMMING

4.1 FAMILIARIZATION TRAINING

- A. The familiarization training shall be provided for this project.
- B. The purpose is to familiarize operators, security management, and technicians with the basic operating components of all control room system. This training will provide operators with sufficient information to monitor the alarm system during system installation, before final system configuration and acceptance has been completed. It will also provide technicians with enough information to provide a basic level of system service during the construction period.
- C. The course shall be taught at the project site for a period of one (1) training day. Generally, the contractor should plan for the course to begin approximately 15 days before scheduled system cut-over. Project management and system installation progress will determine the appropriate time for familiarization training, and the contractor will submit the dates for familiarization training to the Owner within 60 days of proposed date of delivery.
- D. The contractor shall submit for approval the training schedule and course curriculum 30 days prior to course delivery. Course curriculum information shall include written learning objectives for each block of instruction. A maximum of 15 students per day will attend this course.
- E. The general outline for the course will contain, at a minimum, the subject areas listed below. In-depth training in these areas will be addressed in follow-up courses for operators, supervisors and maintenance technicians. Upon completion of the course, operators should be able to perform elementary monitoring operations with guidance and describe the general hardware and architecture of the system.

Day	Attendees	Subject Areas
1	Operators	General security system configuration and architecture System interface familiarity System monitoring components (CCTV and card access) Operator Commands Access to all systems Receive and test individual Login and passwords
2	Supervisors	General system configuration and architecture System interface familiarity System monitoring components (CCTV and card access) All systems operations Operator Commands (override functions) New Room layout Preliminary troubleshooting of all systems
3	Administrator	All functional requirements of the Administrator (all systems)

4	Technicians	Database Entry System Network Configurations (security privileges, setups, etc.) Reports Generation Diagnostics Technicians Basic Maintenance Board Configuration Processor Unit Orientation Installation System back-ups
5	To be determined by Owner	Curriculum shall be one, or a combination of, the above topics.

F. Classroom Configuration

G. The familiarization course will be taught on site. The contractor shall coordinate classroom location and configuration with Owner.

4.2 SYSTEM PROGRAMMING - CONTRACTOR

A. Contractor shall configure and program access control systems as indicated in 1.8.E.2.a.

4.3 SYSTEM PROGRAMMING – COLLEGE

A. College shall configure and program access control system as indicated in paragraph 1.8.E.2.b.

B. College shall program Mobotix cameras.

PART 5 - TESTING AND ACCEPTANCE

5.1 PERFORMANCE REQUIREMENTS

A. General:

1. The Contractor shall perform Contractor field, performance verification, and endurance testing and make adjustments to the completed security system when required. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Owner at least 60 calendar days prior to the test and after the Contractor has received written approval of the specific test procedures.
2. The Owner shall witness all testing and system adjustments during testing. Written permission shall be obtained from the Owner before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Owner at the conclusion of each phase of testing and prior to Owner approval of the test.

- B. Test Procedures and Reports: The test procedures, shall explain in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. The test reports shall be used to document results of the tests. The reports shall be delivered to the Owner within seven (7) calendar days after completion of each test.

5.2 PRE-DELIVERY TESTING

- A. Not Required.

5.3 CONTRACTOR'S FIELD TESTING

- A. The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. Ground rods installed by this Contractor within the base of emergency call box towers shall be tested as specified in IEEE STD 142. The Contractor shall test all security systems and equipment, and provide written proof of a 100% operational system before a date is established for the system acceptance test. Documentation package for CFT shall include completed (fully annotated details of test details) for each device and system tested, and annotated loading sheets documenting complete testing to Montgomery College approval. CFT test documentation package shall conform to submittal requirements outlined in this Section. The Contractor shall provide the Owner with a written listing of all equipment and software indicating all equipment and components have been tested and passed. The Contractor shall deliver a written report to the Owner stating the installed complete system has been calibrated, tested, and is ready to begin performance verification testing; describing the results of the functional tests, diagnostics, and calibrations; and the report shall also include a copy of the approved acceptance test procedure. Performance verification testing shall not take place until written notice by Contractor is received certifying that a Contractors field test was successful.

5.4 PERFORMANCE VERIFICATION TEST (PVT)

- A. The Contractor shall demonstrate the completed ESS complies with the contract requirements. In addition, the Contractor shall provide written certification that the system is 100% operational prior to establishing a date for starting PVT. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The PVT will be stopped and aborted as soon as 10 technical deficiencies are found requiring correction. The Contractor shall be responsible for all travel and lodging expenses incurred for out-of-town personnel required to be present for resumption of the PVT. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.
- B. The PVT, as specified, shall not begin until receipt of written certification that the Contractors Field Testing was successful. This shall include certification of successful completion of testing as specified in paragraph "Contractor's Field Testing", and upon successful completion of testing at any time when the system fails to perform as specified. Upon termination of testing by the Owner or Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II.
- C. Upon successful completion of the acceptance test, the Contractor shall deliver test reports and other documentation, as specified, to the Owner prior to commencing the endurance test.
- D. Additional Components of the PVT shall include:
1. System Inventory
 - a. All Device equipment
 - b. All Software
 - c. All Logon and Passwords
 - d. All Cabling System Matrices
 - e. All Cable Testing Documents
 - f. All System and Cabinet Keys

2. Inspection

- a. Contractor shall record an inspection punch list noting all system deficiencies. The contractor shall prepare an inspection punch list format for Owner's approval.
 - b. As a minimum the punch list shall include a listing of punch list items, punch list item location, description of item problem, date noted, date corrected, and details of how item was corrected.
- E. Partial PVT - At the discretion of the Montgomery College project manager, the Performance Verification Test may be performed in part, and should be 100% compliant CFT be performed. In the event that a partial PVT will be performed instead of a complete PVT; the partial PVT shall be performed by testing 10% of the system. The Contractor shall perform a test of each procedure on select devices or equipment.

5.5 ENDURANCE TEST

- A. The Contractor shall demonstrate the specified probability of detection and false alarm rate requirements of the completed system. The endurance test shall be conducted in phases as specified below. The endurance test shall not be started until the Owner notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. Montgomery College shall operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing. Montgomery College will maintain a log of all system deficiencies. The Owner may terminate testing at any time the system fails to perform as specified. Upon termination of testing, the Contractor shall commence an assessment period as described for Phase II. During the last day of the test, the Contractor shall verify the appropriate operation of the system. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Owner prior to acceptance of the system.
1. Phase I (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the Owner. If the system experiences no failures, the Contractor may proceed directly to Phase III testing after receiving written permission from the Owner.
 2. Phase II (Assessment):
 - a. After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Owner. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
 - b. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Owner. The meeting shall not be scheduled earlier than five (5) business days after the Owner receives the report. As part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Owner will provide a written determine of either the restart date or require Phase I be repeated.

3. Phase III (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the Owner.
4. Phase IV (Assessment):
 - a. After the conclusion of Phase III, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Owner. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
 - b. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Owner. The meeting shall not be scheduled earlier than five (5) business days after receipt of the report by the Owner. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by repeating appropriate portions for the performance verification test. Based on the review meeting the test should not be scheduled earlier than five (5) business days after the Owner receives the report. As a part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Owner will provide a written determine of either the restart date or require Phase III be repeated. After the conclusion of any re-testing which the Owner may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

5.6 EXCLUSIONS

- A. The Contractor will not be held responsible for failures in system performance resulting from the following:
 1. An outage of the main power in excess of the capability of any backup power source provided the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the ESS performed as specified.
 2. Failure of an Owner furnished equipment or communications link, provided the failure was not due to Contractor furnished equipment, installation, or software.
 3. Failure of existing Owner owned equipment, provided the failure was not due to Contractor furnished equipment, installation, or software.

END OF SECTION 280500

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Refer to 280500 Part 1

1.2 RELATED DOCUMENTS

- A. Refer to 280500 Part 1

1.3 RELATED DIVISION PROVISIONS

- A. Refer to 280500 Part 1

1.4 REFERENCES

- A. Refer to 280500 Part 1

1.5 SUMMARY

- A. Section Includes:
 - 1. UTP cabling.
 - 2. 62.5/125-micrometer, multimode optical fiber cabling.
 - 3. Cat6 data cabling
 - 4. RS-232 cabling.
 - 5. RS-485 cabling.
 - 6. Low-voltage control cabling.
 - 7. Control-circuit conductors.
 - 8. Identification products.

1.6 DEFINITIONS

- A. Refer to 280500 Part 1

1.7 SUBMITTALS

- A. General: Submittal shall be a component of Section 280500 submittal requirements.
- B. Qualification Data: For qualified layout technician, installation supervisor, and field inspector. Refer to 280500 Part 1 "Quality Assurance".
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Maintenance Data: For wire and cable to include in maintenance manuals.

1.8 COORDINATION

- A. Refer to 280500 Part 1

1.9 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 300 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.10 MAINTENANCE & SERVICE

- A. Refer to 280500 Part 1

1.11 SYSTEM DESCRIPTION

- A. The system shall be coordinate with 280500.

- 1.12 PERFORMANCE REQUIREMENTS
 - A. Refer to 280500 Part 1

- 1.13 PROJECT CONDITIONS

- 1.14 EQUIPMENT AND MATERIALS
 - A. Refer to 280500 Part 1

- 1.15 ELECTRICAL POWER
 - A. Refer to 280500 Part 1

- 1.16 ENVIRONMENTAL CONDITIONS
 - A. Refer to 280500 Part 1

- 1.17 LIGHTNING, POWER SURGES, & GROUNDING
 - A. Refer to 280500 Part 1

- 1.18 COMPONENT ENCLOSURES
 - A. Refer to 280500 Part 1

- 1.19 ELECTRONIC COMPONENTS
 - A. Refer to 280500 Part 1

- 1.20 SUBSTITUTE MATERIALS & EQUIPMENT
 - A. Refer to 280500 Part 1

- 1.21 LIKE ITEMS
 - A. Refer to 280500 Part 1

1.22 WARRANTY

- A. Refer to 280500 Part 1

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General: All cabling locations shall be in conduit systems as outlined in Division 26 unless a waiver is granted in writing or an exception is noted on the construction drawings.
- B. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 2 x 3 x 2.5 in.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, .75 x 48 x 96 in minimum with actual dimensions to match panel assembly sizing. Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry." or meet SI OSHEM specifications. The manufacturer's stamp indicating fire retardant shall not be painted over.

2.3 GENERAL WIRE AND CABLE REQUIREMENTS

- A. General: All wire and cable components shall be able to withstand the conditions under which the wire or cable is installed in for a minimum of 20 years without degradation. All wiring shall meet or exceed manufacturers recommended wire specifications and be listed for intended operation. Provide distinct color coding system for all wiring. Each cable shall be numbered at each end with permanent labels.
 - 1. Primary transmission media used for the CCTV System shall be UTP Cat6 cable.
 - 2. The use of Cat6 cable is for cameras and NVR connection to Owner provided Ethernet network.
 - 3. The Contractor shall furnish all wire conductors, cables, interfaces, and connectors as required by the system.
 - 4. Any sensor wire run in wire ducts or troughs where other wiring is present shall be shielded with the shield grounded only at the panel end.

5. All cabling in racks, cabinets and junction boxes shall be neatly strapped, dressed and adequately supported. Cable installation shall conform to good engineering practices and to the standards of the current NFPA 70.
6. In all cases, wire conductors and all cables utilized for the connection of the various components as specified herein, including those components provided by others, shall comply with or exceed the recommendations of the component manufacturers.
7. All wire and cable provided by the Security Contractor shall comply with all applicable codes and ordinances.
8. It shall be the Security Contractor's responsibility to perform all engineering calculations required to ensure the proper cable sizes are provided, so the specified equipment will perform as shown in the manufacturer's specifications. All engineering calculations shall be provided with the prefabrication submittals. It shall be the Security Contractor's responsibility to obtain and verify the power requirement of NIC, electrified locksets, electrified panic device before carrying out any engineering calculations.
9. Independent of manufacturer's recommendations, cables utilized for signal circuits shall incorporate stranded conductors of not less than 22 AWG. Conductor sizes shall be increased as required to accommodate specific applications and unusual distances.
10. Independent of manufacturer's recommendations, cables utilized for low voltage power circuits shall incorporate stranded conductors of not less than 18 AWG with red and black colored insulation. The red conductor shall be connected as the positive (+) polarity and the black conductor shall be connected as the negative (-) polarity. Conductor sizes shall be increased as required to accommodate specific applications.

B. Specific Requirements:

1. Wire and cable shall be Belden Corporation, Alpha Wire Company, West Penn Wire or equivalent.
2. Wire and cable jacket color shall comply with the facility standard.

2.4 DIGITAL DATA WIRING

- A. Cables serving interconnects of digital data between components at the security center or at remote control/monitoring station shall comply with Owner requirements and be C wire for each conductor. The hardwire cable shall contain a 100 percent shielding when shielding is specified. Wires with a single overall shield shall have a tinned copper shield drain wire. Shields shall be grounded at the connecting panel end only and in accordance with manufacturer's recommendations.

2.5 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CM or CMG.

1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.

2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.6 CAT 6 CABLE

A. Premise Horizontal Cable, Gigabit Ethernet, 100BaseTX, 100BaseVG ANYLAN, 155ATM, 622ATM, NTSC/PAL Component or Composite Video, AES/EBU, Digital Video, RS-422

B. Standard Cable:

1. Paired, 4 pairs, twisted, No. 24 AWG, solid bare copper conductors.
2. Unshielded.
3. LSZH - Low Smoke Zero Halogen jacket.

C. Plenum Cable:

1. Paired, 4 pairs, twisted, No. 23 AWG, solid bare copper conductors.
2. FEP - Fluorinated Ethylene Propylene.
3. Unshielded.
4. LSZH - Low Smoke Zero Halogen jacket.

2.7 LOW-VOLTAGE CONTROL CABLE

A. Card Reader Cable: NFPA 70, CM (2 Cables).

1. RS485: 1 pair, twisted shielded, No. 22 AWG, Stranded tinned copper conductors.

2. 12VDC Power: 1 pair, twisted, No 18 AWG, Stranded tinned copper conductors,
3. PVC Insulation.
4. Flame Resistance: Comply with UL 1581.

B. Paired Lock Power Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

C. Plenum-Rated, Paired Lock Power Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.8 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway or conduit complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.9 CABLE IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Brady Corporation
 2. HellermannTyton.

3. Kroy LLC.
4. Panduit Corp.
5. EZ Label.
6. Or equivalent.

- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Cable will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 GENERAL

A. Wire: The following security provisions apply to systemizing requirements:

1. All security system wiring must be new. All existing wiring not noted for reused and replaced shall be removed.
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer and compatible with the security system. Number and size and type of conductors shall be as recommended by the security system manufacturer, but not less than 22 AWG twisted shield pair. Network and computer devices may require 24 AWG solid copper conductors for video/data transmission (e.g., TCP/IP, VGA Video) as recommended by the equipment manufacturer.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for intended application and use with a protective signaling system. Provide 300 VAC/60° C rated insulated conductors unless noted otherwise.
4. Wire and cable in air circulation areas which is not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
5. Wiring used for the multiplex communication loop shall be twisted and shielded and installed in conduit unless specifically accepted by the security equipment manufacturer.
6. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring, a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.

B. Method of Wiring

1. General: Wire each alarm, trouble, and supervisory signal, initiating circuit, communication circuit, and each security notifying appliance circuit for supervised operation.
2. Wiring within Cabinets: Provide wiring within cabinets installed parallel with or at right angles to the sides and back of the enclosure. All conductors which are terminated, spliced, or otherwise interrupted in any enclosure associated with the security system shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make all connections with either crimp-on terminal spade lugs or approved pressure type terminal blocks. Terminal blocks shall be secured in each junction box to the junction box cover plate.
3. Interior Work: Cables installed in plenums shall meet UL 910, and cables to be installed in risers shall meet UL 1666.

4. Installation in Ducts or Conduits: A cable lubricant compatible with the cable sheathing material shall be used on all cables pulled. Pulling fixtures shall be attached to the cable strength members. If indirect attachments are used, the grip diameter and length shall be matched to the cable diameter and characteristics. If indirect attachment is used on cables having only central strength members, the pulling forces shall be reduced to ensure the fibers are not damaged from forces being transmitted to the strength member. During pulling the cable pull line tension shall be continuously monitored and not exceed the maximum tension as given by the cable manufacturer. The mechanical stress placed upon a cable during installation shall not twist or stretch the cable.
 - a. A cable feeder guide shall be used between the cable reel and the face of the duct or conduit to protect the cable and guide it into the duct or conduit as it is played off the reel. As the cable is played off the reel, it shall be carefully inspected for jacket defects. Precautions shall be taken during installation to prevent the cable from being kinked or crushed and the minimum bend radius of the cable is not exceeded at any time. Cable shall be hand fed and guided through each manhole and additional lubricant shall be applied at all intermediate manholes.
 - b. When practicable, the center pulling techniques shall be used to lower pulling tension. That is, the cable shall be pulled from the center point of the cable run towards the end termination points. The method may require the cable to be pulled in successive pulls. If the cable is pulled out of a junction box or manhole the cable shall be protected from dirt and moisture by laying the cable on a ground covering.
5. Vertically Run Cable: When possible, use gravity to assist in cable pulling; pull cable from top of run to bottom of run. Hand-pull cables if possible; if machine assistance is required, monitor tension and do not exceed the specific cable tension limits. After installation, the vertical tension on the cable shall be relieved at maximum intervals of 30.48 m (100 ft) using a split support grip.
6. Cable Taps: The Contractor shall provide a terminal cabinet where any circuit tap is made.
7. Color Coding: The Contractor shall distinctively color code all wiring differently from the normal building wiring. Identify conductors by plastic-coated, self-sticking, printed markers or by heat-shrink type sleeves. Wire the alarm initiating and notification signal devices so removal will cause the system trouble device to sound. Each conductor used for the same specific function shall be distinctively color coded. Use two (2) different color codes for each interior alarm circuit; one (1) for each loop. Each circuit color code wire shall remain uniform throughout the circuit.
8. Termination: End-of-line supervisory resistors or devices are to be provided at the sensor device location. The end of line resistor network shall be per manufacturer's recommendations; in the absence of such, it shall consist of two (2) 1k resistors, one (1) across the normally closed contact of the device and the other in series with the normally closed circuit. See drawing details for further information. Use of GRI Resistor Packs is preferred.
9. No "stick-on" cable ties shall be used within the enclosure.

C. Cable Installation

1. All field wiring required for interconnection of the various security system components shall be installed within conduit.
2. All circuits shall be protected to avoid interruption of service due to short-circuiting or other conditions which may adversely affect the connecting devices. Each individual signaling circuit shall be classified as a circuit pair.
3. Screw terminal blocks or connectors shall be furnished for all cables which interface with racks, cabinets, consoles or equipment modules. No more than 2 mm of exposed bare wire may show when either crimped or fastened to a connector block or terminal strip.
4. Every cable or wire shall be permanently labeled at each end. Marking labels used on cables shall correspond to labels shown on as-built drawings and matrix sheets. Utilize a cable administration and labeling solution compliant TIA/EIA-606-A, such as Panduit TIA/EIA-606-A compliant Cable Identification and Labeling System. Wire cable numbers cannot repeat anywhere on the project. Each terminal of each field terminal strip shall be permanently labeled to show the zone, instrument or item served. Terminal blocks shall be numbered by circuit pairs, such as 1 to 25, 26 to 50, etc.
5. Care shall be exercised in wiring to avoid damage to the cables or the equipment. All joints and connections shall be made with mechanical butt splice connectors. The crimping tool used shall be recommended by the manufacturer. Wire nuts shall not be an acceptable splice method.
6. To reduce the possibility of signal contamination, all cables shall be grouped according to the signals being carried. The horizontal and vertical cable runs should be bundled or grouped as follows:
 - a. Low Voltage Power
 - b. Signal, Control Cables, and Video Cables
7. All cabling shall be U.L. listed for its intended application and meet or exceed the standards as recommended by the manufacturers of the components being interconnected. All shielded cabling used shall be 100 percent shielded.
8. All system wiring shall be installed in accordance with the instructions provided by the manufacturers of the components being used in the system and in accordance with codes, specifications, and standards as referenced herein.
9. Splices shall not be permitted in system wiring between components which are incorporated in the system. Wiring runs must terminate at either a system component or a junction box where wiring is interconnected using terminal strips or connectors. Wire ends shall be prepared for attachment to component terminals in accordance with the recommendations of the equipment manufacturers. If there is no alternative and a wire/cable splice must be made, the Contractor shall notify the Owner and request approval through a formal RFI process prior to making the wire splice.
 - a. The RFI shall include the following:
 - 1) The Contractor shall identify the device and/or system affected by the proposed splice and why the splice is required.
 - 2) Provide in detail the methodology which shall be utilized for the wire/cable splice. A diagram may be used to demonstrate methodology but shall not replace the written methodology requirement.

- 3) If splicing is required for more than five (5) wires/cables, a formal wire management plan shall be developed to provide methodology for maintaining wire/cable consistency and performance.
 - 4) In all instances the Contractor shall provide the Owner with a mock-up of the proposed splice and samples of the materials to be used.
 - 5) The Contractor shall not proceed until written approval has been received from the Owner for the splice and the splice materials.
- b. The following criteria shall be utilized for installing wire/ cable splices.
- 1) Twist type connectors shall not be used for wire splicing.
 - 2) Wire splices shall be made on binding screw captive mechanical compression terminal strips.
 - 3) Soldered and crimped connections are allowed and shall be accomplished with crimping Lug Manufacturers Calibrated Tool.
 - 4) Solder connections shall be applied in accordance with BICSI standards.
 - 5) Mechanical splices shall utilize a UL listed ratchet type connector. The Contractor shall select the appropriate connector size based on gauge of the wire/cable being spliced. The Contractor shall only use manufacture approved full cycle ratchet crimping devices.
 - 6) The Contractor shall utilize appropriately sized UL listed heat shrink tubing. Splices shall be encapsulated with an epoxy or ultraviolet light cured splice encapsulator, particularly if the spliced wire/cable is direct-buried, environmentally exposed, or located in an exterior hand hold.
 - 7) The Contractor shall ensure all completed splices are accessible. Splices shall be made in lockable/tampered security enclosures or in security junction/pull boxes that use tamper proof Torx Center post security screws to secure the box cover. At no time shall spliced wires/cables be permitted to be pulled into the conduit system.
 - 8) For all splices, the Contractor shall affix a permanent label (self-adhesive or heat shrink type) to the wire/cable adjacent to the splice. The label shall indicate the device or circuit the wire/cable originates at. The label shall be identical to the labels found at either terminated end of the wire/cable.
 - 9) All spliced wires/cables shall be tested in witness of the COTR to ensure system performance is not adversely affected by the splices' presence.
- c. All copper conductor splices shall be accomplished in the following method:
- 1) Strip insulation from wires to be spliced using caution not to score or strip away the actual conductor.
 - 2) Twist together the stripped conductors for a minimum of four rotations.
 - 3) Solder the twisted conductors using rosin core solder.
 - 4) Trim the twisted and soldered conductors to a length accommodated by the vinyl insulated closed end splice or butt splices in the next step. Trimmed bare conductors shall not extend beyond the insulated closed end splice (or equal).
 - 5) Crimp insulated closed end splice utilizing a full cycle ratchet crimp tool approved by the splice manufacturer. The crimped connections shall be free of any movement between the wire and crimp splice device.
10. Connections at devices shall be soldered or fastened with approved crimp connectors. No wire nuts will be permitted. Wire should be twisted four times before a crimp connector is applied. The Manufacturers crimping tool shall be utilized for the crimp

connectors of choice. Environmental connectors shall be used in harsh or outdoor environments. Devices requiring connections within metal extrusions associated with perimeter windows and doors are considered to be a harsh environment.

11. All mounted wire ties shall be the screw down type. Wire ties utilizing only an adhesive back are not acceptable.
12. Heat shrink tubing must be installed on all cable ends within cabinets.
13. Cable shields are to be grounded only at the DGP end, for alarms and CCTV. Shields are to be carefully insulated to prevent conductor shorts.
14. Permanent labels, attached to each cable end, shall be close to cable ends in cabinets and not hidden from view by cable ties. Labels must be visible without having to cut cable ties to read the number.

D. Grounding Practices

1. The existing single system ground point shall be maintained for all security and security related systems described in the BICSI guidelines and is to be provided and installed by the Contractor.
2. Under no circumstances shall either the conduit or AC neutral be used for the security system ground reference point.

E. Control of Electromagnetic Interference (EMI)

1. The control of EMI is critical to the reliable operations of the systems described in these specifications. It is the responsibility of the Security Contractor to ensure all equipment and systems proposed meet FCC requirements and certifications for type regarding electromagnetic emissions. The Security Contractor shall submit evidence of such certifications with their pre-fabrication submittals.
2. All equipment shall be installed in accordance with manufacturers' specifications and recommendations to assure compliance with FCC certifications and requirements. This shall include proper installation to maintain case integrity; proper fastening of conductors, wires, cables, and connectors; use of appropriate connectors and fasteners; and following manufacturers' recommendations for grounding practices.
3. The Security Contractor shall certify compliance with manufacturers' recommendations and specifications regarding control of EMI.

3.2 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of the room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 75 mm (3 in) above finished floor (AFF).
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 2440 mm (96 in) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 760 mm (30 in) and not more than 150 mm (6 in) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 9. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable". Monitor cable pull tensions.
- C. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend copper cable not in a wireway or pathway a minimum of 200 mm (8 in) above ceilings by cable supports not more than 1525 mm (60 in) apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Coil cable 1830 mm (72 in) long shall be neatly coiled not less than 300 mm (12 in) in diameter below each feed point.
- E. Separation from EMI Sources
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 127 mm (5 in).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 300 mm (12 in).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 600 mm (24 in).
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2.5 in.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 in.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 in.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 75 mm (3 in).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 150 mm (6 in).

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 1200 mm (48 in).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 127 mm (5 in).

3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.5 CONNECTIONS

- A. Comply with requirements in Division 28 Section "Access Control" for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in Division 28 Section "Video Surveillance" for connecting, terminating, and identifying wires and cables.

3.6 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping".
- B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.7 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 CABLE IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.10 WIRELINE DATA TRANSMISSION

- A. Installation: The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and as shown, and furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable data transmission system.
- B. Identification and Labeling: The Contractor shall supply permanent identification labels for each cable at each end that will appear on the as-built system loading sheets. The labeling format shall be identified and a complete record shall be provided to the COTR with the final documentation. Each cable shall be identified by type or signal being carried and the termination points. The labels shall be printed on letter size label sheets that are self laminated vinyl which can be printed from a computer data base or spread sheet. The labels shall be E-Z code WES12112 or equivalent. Contractor shall create a unique cable identification system where no two cables will have the same identification label.
- C. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.
- D. Identification and Labeling: The Contractor shall supply identification tags or labels for each cable. Cables shall be labeled at both end points and at intermediate hand holes, manholes, and junction boxes. The labeling format shall be identified and a complete record shall be provided to the COTR with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

PART 4 - TESTING AND ACCEPTANCE

4.1 TESTING

A. Wire Line Test: The Contractor shall test each wireline pair. The Contractor shall prepare reports containing test results and certify in the reports conformance to the following requirements:

1. Attenuation: Measurements shall be made with test tone of 1,004 Hz at 0dBm. Attenuation distortion not to exceed minus three (-3) dB to 12 dB from 300 to 3,000 Hz, and minus two (-2) dB to eight (8) dB from 500 to 2,500 Hz referenced to the attenuation of the 1,004 Hz test tone. Attenuation at 1,004 Hz of less than 40 dB.
2. Envelope Delay: Envelope delay distortion no greater than 1,750 microseconds over a range of 800 to 2,600 Hz.
3. Insulation Resistance: Insulation resistance wire to wire of wireline pair of at least 10,000 megohm-miles measured at 24 deg C (72 deg F).
4. Loop Resistance: Loop resistance of less than 1,000 ohms with end of line resistance > 50 ohms.

B. Cat 6 cable field test requirements

1. Every cabling link in the installation shall be tested for:
 - a. Wire Map
 - b. Length
 - c. Insertion Loss
 - d. NEXT Loss
 - e. PS NEXT Loss
 - f. ACR-F Loss
 - g. PS ACR-F Loss
 - h. Return Loss
 - i. Propagation Delay
 - j. Delay Skew
2. The installed twisted-pair horizontal links shall be tested from the IDF in the telecommunications room to the telecommunication wall outlet in the work area for compliance with the "Permanent Link" performance specification as defined in the Category 6 Standard.
3. One hundred percent of the installed cabling links must pass the requirements of the Category 6 Standard mentioned in A.1 above and as further detailed in Section B. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Section C below.
4. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training

programs include but are not limited to installation certification programs provided by BiCSi or the ACP (Association of Cabling Professionals).

5. The test equipment (tester) shall comply with the accuracy requirements for level III field testers as defined in ANSI/TIA-1152. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 3 of ANSI/TIA-1152 (Table 3 in this TIA document also specifies the accuracy requirements for the Channel configuration).
6. The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.
7. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
8. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
9. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests (detailed in Section 4.2.2 of ANSI/TIA-1152). Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.
10. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks. To which extent "*" results shall determine approval or disapproval of the element under test shall be defined in the relevant detail specification, or agreed on as a part of a contractual specification.
11. Test Result Documentation
 - a. The test results/measurements shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., "as saved in the tester" at the end of each test and that these results cannot be modified at a later time.
 - b. The database for the completed job shall be stored and delivered on CD-ROM or DVD including the software tools required to view, inspect, and print any selection of test reports.
 - c. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information
 - 1) The identification of the link in accordance with the naming convention defined in the overall system documentation

- 2) The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number
 - 3) The date and time the test results were saved in the memory of the tester.
- d. General Information to be provided in the electronic data base with the test results information for each link:
- 1) The identification of the customer site as specified by the end-user
 - 2) The identification of the link in accordance with the naming convention defined in the overall system documentation
 - 3) The overall Pass/Fail evaluation of the link-under-test
 - 4) The name of the test limit selected to execute the stored test results
 - 5) The cable type and the value of NVP used for length calculations
 - 6) The date and time the test results were saved in the memory of the tester
 - 7) The brand name, model and serial number of the tester
 - 8) The identification of the tester interface
 - 9) The revision of the tester software and the revision of the test limits database in the tester
 - 10) The test results information must contain information on each of the required test parameters that are listed in Section B and as further detailed below under paragraph C5.
- e. The detailed test results data to be provided in the electronic database for must contain the following information:
12. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
- a. Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m (1) and the test limit value
 - b. Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value
 - c. Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value
 - d. Insertion Loss (Attenuation): Minimum test results documentation as explained in Section B for the worst pair
 - e. Return Loss: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link
 - f. NEXT, ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link
 - g. PS NEXT and PS ACR-F: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link

C. Contractor's Field Test: The Contractor shall verify the complete operation of the data transmission system during the Contractor's Field Testing. Field test shall include a bit error rate test. The Contractor shall perform the test by sending a minimum of 1,000,000 bits of data on each DTM circuit and measuring the bit error rate. The bit error rate shall not be greater than 1 bit out of each 100,000 bits sent for each dial-up DTM circuit, and 1 bit out of 1,000,000

bits sent for each leased or private DTM circuit. The Contractor shall submit a report containing results of the field test.

- D. Acceptance Test and Endurance Test: The wire line data transmission system shall be tested as part of the completed IDS and EECS during the Acceptance test and Endurance Test as specified.

END OF SECTION 280513

SECTION 281300 - ACCESS CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Refer to 280500 Part 1

1.2 RELATED DOCUMENTS

- A. Refer to 280500 Part 1

1.3 RELATED DIVISION PROVISIONS

- A. Refer to 280500 Part 1

1.4 REFERENCES

- A. Refer to 280500 Part 1

1.5 SUMMARY

- A. This Section includes access control devices to be connected to the Security Management System (SMS).
 - 1. Access Control:
 - a. Regulating access through doors, gates, traffic-control bollards and others access controls as specified in drawing documents.
 - b. Anti-passback where required.
 - c. Surge and tamper protection.
 - d. Secondary alarm annunciator.
 - e. Card readers.
 - f. Biometric identity verification equipment.
 - g. Push-button switches.
 - h. RS-232 ASCII interface.
 - i. Reporting.

1.6 DEFINITIONS

- A. Refer to 280500 Part 1

1.7 SUBMITTALS

- A. Refer to 280500 Part 1

1.8 COORDINATION

- A. Refer to 280500 Part 1

1.9 QUALITY ASSURANCE

- A. Refer to 280500 Part 1

1.10 MAINTENANCE & SERVICE

- A. Refer to 280500 Part 1

1.11 SYSTEM DESCRIPTION

- A. Refer to 280500 Part 1

1.12 PERFORMANCE REQUIREMENTS

- A. Refer to 280500 Part 1

1.13 DELIVERY HANDLING & STORAGE

- A. Refer to 280500 Part 1

1.14 PROJECT CONDITIONS

- A. Refer to 280500 Part 1

1.15 EQUIPMENT AND MATERIALS

- A. Refer to 280500 Part 1

- 1.16 ELECTRICAL POWER
 - A. Refer to 280500 Part 1

- 1.17 ENVIRONMENTAL CONDITIONS
 - A. Refer to 280500 Part 1

- 1.18 LIGHTNING, POWER SURGES, & GROUNDING
 - A. Refer to 280500 Part 1

- 1.19 COMPONENT ENCLOSURES
 - A. Refer to 280500 Part 1

- 1.20 ELECTRONIC COMPONENTS
 - A. Refer to 280500 Part 1

- 1.21 SUBSTITUTE MATERIALS & EQUIPMENT
 - A. Refer to 280500 Part 1

- 1.22 LIKE ITEMS
 - A. Refer to 280500 Part 1

- 1.23 WARRANTY
 - A. Refer to 280500 Part 1

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Security Management System Software
 - 1. GE Security Facility Commander
- B. Security Management System Field Hardware
 - 1. GE Security ACULX16 Network Intelligent Controller – No Exception
 - 2. GE Security Remote Reader Electronics – No Exception
- C. Card Reader
 - 1. HID Thin Line II Proximity Card Reader – No Exception
 - 2. HID Mini Prox Reader

2.2 FACILITY COMMANDER SECURITY MANAGEMENT PLATFORM

- A. Security devices and hardware shall be integrated with the Owner's existing Security Management system (SMS). The SMS server is located in the main MDF room of the Computer Science Center located on the Montgomery College, Rockville, MD campus. Security devices and hardware provided under this project shall communicate with the SMS server via the Owner's proprietary MC F-Net network. Network Intelligent Controllers shall be terminated at the Owner furnished, Contractor (by others) installed MC F-Net switches.
- B. The Contractor is responsible for providing all software licenses required to complete this work.

2.3 NETWORK INTELLIGENT CONTROLLER

- A. General:
 - 1. The Networked Intelligent Controller (NIC) shall be a microprocessor-based device, which utilizes a 32-bit processor and a 32-bit bus structure. The controller shall have a minimum clock speed of 90 MHz, and shall be provided with at least 16 Mbytes of battery backed dynamic RAM. The controller shall feature a direct LAN/WAN connection to the controller bus structure in addition to two RS-232 or RS-485 connections, all of which should be designed for use in communication with the ACAM server. The communication architecture of the NIC shall be such that in the event that the primary communication channel to the ACAM server is lost, the unit shall be capable of automatically switching to a secondary communication channel using one of the host RS-232 or RS-485

- connections, and if required shall be able to establish communications via dial-up modem.
2. The NIC shall be provided with a parallel printer port, which will enable it to print transaction data during loss of communication with the ACAM server. The NIC shall be capable of dynamically allocating its memory between database information and transaction history, which shall be stored if the controller has lost communication with the ACAM server. Such transaction history shall be automatically uploaded to the ACAM server once communication has been restored. In its maximum configuration, the NIC shall be capable of storing 250,000 cardholders, and its memory utilization shall be such that if storing database information for 10,000 cardholders, it shall also be capable of storing 500,000 transactions.
 3. The NIC shall support the monitoring and control of 16 card readers, with or without keypads. It shall also be provided with at least 12 five-state, fully supervised and fully configurable input points, and at least 12 fully configurable auxiliary output control relays mounted on the main circuit board.
 4. Each controller must also be capable of expansion, by external Remote Input Modules (RIMs) and/or Remote Relay Modules (RRMs), to support a combination of up to 172 fully configurable five-state supervised input points or 156 output relays per NIC depending on configuration.
 5. Each NIC shall be provided with a UL Listed uninterruptible power supply (UPS) mounted within the NIC enclosure. It shall provide sufficient battery backup to sustain complete operational effectiveness including Remote Reader Electronic (RRE) modules, card readers, electric locks (fail secure), RIMs and RRM's for a minimum of four [eight] hours of normal operation.
 6. Each NIC shall utilize on-board self-diagnostic LEDs, removable terminal strips and a pop-in/pop-out circuit board.
 7. Each NIC in addition to its on-board LAN/WAN connection shall support RS-232 and multi-drop RS-485 communication topologies. Provision of external LAN terminal server devices that are connected through serial communications to the NIC are not acceptable.
 8. Each NIC shall support RS-485 bi-directional communication paths (dual multi-drop paths back to ACAM file server) with no additional hardware or firmware required.
 9. Each NIC shall be supplied with all specified options available, including a locking enclosure with a tamper switch.
 10. Each NIC shall be capable of reporting the following alarm conditions to the ACAM file server:
 - a. enclosure door tamper
 - b. primary power failure
 - c. low battery conditions
 - d. loss of communications
 - e. all access control violations.
 11. The Network Intelligent Controller shall be a GE Security ACULX 16

2.4 REMOTE READER ELECTRONIC MODULES

A. General

1. The Remote Reader Electronic (RRE) modules shall be provided to support all card readers, door contact switches, request-to-exit devices and electric locks. The RRE modules shall support all industry standard card reader technologies (magnetic stripe, Wiegand, bar code, barium ferrite, and proximity) as well as keypads and compatible biometric devices. These modules shall be available in configurations suitable to support the connection of one, two or four card devices as required.
2. Each RRE module shall support five-state supervised input points, output relays, and shall provide power outputs of 5-VDC, 12-VDC and 24-VDC output at 500-mA to power card readers, biometric devices, request to exit (REX) devices and door strikes. Each RRE module shall be capable of being powered by the on-board UPS of a NIC to avoid the need for power supplies and 115-volt outlets to be located near controlled doors. Each RRE shall also be capable of being powered by a local 24-VDC UPS where required.
3. RRE modules shall utilize on-board self-diagnostic LEDs, removable terminal strips and pop-in/pop-out circuit boards.
4. RRE modules shall be supplied with all specified options available, including an enclosure with an enclosure tamper switch.
5. Quantity and location of RRE modules shall be as specified in Contract Documents and drawings.

2.5 ACULX 16 NETWORK INTELLIGENT CONTROLLER POWER SUPPLY

- A. The ACULX 16 requires a power supply/charger that transforms 120 VAC to 27.5 VDC. The Contractor shall provide the ACU-8APWR power supply/charger assembly to power the ACULX 16 and the supporting RREs. The ACU-8APWR becomes an uninterruptible power supply when stand-by batteries are connected. It has a special power limiting circuit that allows the batteries to be charged. The batteries are protected with an automatic resetting circuit breaker and diode for over current and accidental reversed battery hookup. Float charging means faster recovery time for the batteries. There is no switch over or voltage drop when power fails. Contractor shall size batteries of 8 hours of backup power with a connected load.

2.6 ACCESS CONTROL POWER SUPPLY

- A. Electrified locksets shall be powered from a power supply that is exclusively for electrified locks. The power supply shall provide eight (8) fused protected Fail Secure and/or Fail Safe 24VDC 10 Amps outputs. Power supply shall be a filtered, electronically regulated power source with a built in charger. The power supply shall be provided with sealed gel type batteries for backup power. In the event primary power fails, the power supply shall automatic switch-over to standby battery power, and back when primary power is restored. The transfer to and from backup power shall not cause other electrical anomalies such as false alarms loss of communication etcetera. The power supply shall be provided with thermal and short circuit

protection with auto reset, fused battery protection, AC input and DC output LED indicators, and AC power and low battery supervision relays (Form "C", SPDT).

- B. Each 24 VDC power supply shall be supplied with a minimum of two 12 VDC 7 AH rechargeable batteries for standby power operation. If necessary, additional batteries shall be supplied by the Contractor to meet a four (4) hour standby time.
- C. All power supplies shall be labeled with permanent labels for their intended purpose and input and output voltage. AC ground shall have continuity to both the mounting panel and the housing. If necessary, the Contractor shall provide grounding straps from the mounting board to the housing.
- D. Power Supply shall feature a fire alarm disconnect. The fire alarm disconnect can be latch or non-latching and is individually selectable for any or all of the 8 outputs. The fire alarm disconnect can be either Normally Open (NO) or Normally Closed (NC).
- E. Acceptable equipment shall be Altronix Power Supply AL1024ULACM or equivalent.

2.7 CARD READERS

A. Proximity Card Readers

- 1. Provide surface mounting style 125 KHz proximity card readers suitable for wall or US 2-S single-gang box mounting, and for mounting configurations as shown on the project plans.
- 2. The reader shall be capable of reading access control data in standard Wiegand formats up to 84 bits in length from any HID Proximity card or equivalent, outputting the data in one of the following configurations:
 - a. The card reader shall output credential data in compliance with the SIA AC-01 Wiegand standard, compatible with all standard access control systems.
 - b. The card reader shall output credential data using a Clock and Data interface, and be compatible with systems requiring a magnetic stripe reader.
- 3. The reader shall be capable of outputting a periodic reader supervision message at a configurable time interval, enabling the host system to signal an alarm condition based on the absence of this message.
- 4. The Proximity card reader shall provide the ability to change operational features in the field through the use of a factory-programmed command card. Command card operational programming options shall include:
 - a. Reader beeps and flashes green on a card read, LED normally red, single line control of LED.
 - b. Reader flashes green on a card read, LED normally red, single line control of LED.
 - c. Reader beeps on a card read, LED normally red, single line control of LED.
 - d. Beeper and LED are controlled by host only, LED normally red, single line control of LED.

- e. Reader beeps and flashes green on a card read, LED normally off, red and green LED's controlled individually.
 - f. Reader flashes green on a card read, LED normally off, red and green LED's controlled individually.
 - g. Reader beeps on a card read, LED normally off, red and green LED's controlled individually.
 - h. Beeper and LED are controlled by host only, LED normally off, red and green LED controlled individually
 - i. Change from Wiegand to Mag Stripe output format
 - j. Change from Mag Stripe to Wiegand output format
 - k. Reset to Factory Defaults
5. Proximity card readers shall provide the following programmable audio/visual indication:
- a. A piezoelectric sounder shall provide an audible tone upon successful power up/self test, good card read, or whenever the beeper control line is asserted by the host.
 - b. A bi-color, red/green LED shall light upon successful power up/self test, good card read, or whenever the LED control line(s) are asserted by the host.
 - c. The reader shall have individual control lines for the sounder, and for red and green LED indication. When the LED control lines are asserted simultaneously, an amber LED indication will occur.
6. The reader shall have a configurable hold input, which when asserted shall either buffer a single card read or disable the reader, until the line is released. This input may be used for special applications or with loop detectors.
7. The reader shall require that a card, once read, must be removed from the RF field for one second before it will be read again, to prevent multiple reads from a single card presentation and anti-passback errors.
8. Proximity card readers shall meet the following physical specifications:
- a. Dimensions: 4.70 x 3.0 x 0.68" (11.9 x 7.6 x 1.7 cm)
 - b. Weight: 3.3.oz (94 g)
 - c. Material: UL94 Polycarbonate
 - d. Two-part design with separate reader body and cover.
 - e. Color: Black, Gray, White or Beige as approved by the project architect.
9. Proximity card readers shall meet the following electrical specifications:
- a. Operating voltage: 5– 16 VDC, reverse voltage protected. Linear power supply recommended.
 - b. Current requirements: (average/peak) 20/115mA @ 12 VDC
10. Proximity card readers shall meet the following environmental specifications:
- a. Operating temperature: -22 to 150 degrees F (-30 to 65 degrees C)
 - b. Operating humidity: 0% to 95% relative humidity non-condensing
 - c. Weatherized design suitable to withstand harsh environments The reader shall be of potted, polycarbonate material, sealed to a NEMA rating of 4X (IP55).
11. Proximity card reader cabling requirements shall be:

- a. Cable distance: Wiegand: 500 feet (150m); Clock & Data: 50 feet (15m)
 - b. Cable type: 5-conductor #22 AWG w/overall shield. Additional conductors will be required for 2-line LED control, beeper, hold, or card present functions.
 - c. Standard reader termination: 18" (.5m) cable pigtail
12. Warranty of Proximity card readers shall be lifetime against defects in materials and workmanship.
 13. Proximity card reader shall be HID Corporation Model Thinline II.

B. Proximity Card Reader (Mullion Mount)

1. Provide surface mounting style 125 KHz proximity card readers suitable for door or window mullion mounting, and for minimal space mounting configurations as shown on the project plans.
2. The reader shall be capable of reading access control data in standard Wiegand formats up to 84 bits in length from any HID Proximity card or equivalent, outputting the data in one of the following configurations:
 - a. The card reader shall output credential data in compliance with the SIA AC-01 Wiegand standard, compatible with all standard access control systems.
 - b. The card reader shall output credential data using a Clock and Data interface, and be compatible with systems requiring a magnetic stripe reader.
3. The reader shall be capable of outputting a periodic reader supervision message at a configurable time interval, enabling the host system to signal an alarm condition based on the absence of this message.
4. The Proximity card reader shall provide the ability to change operational features in the field through the use of a factory-programmed command card. Command card operational programming options shall include:
 - a. Reader beeps and flashes green on a card read, LED normally red, single line control of LED.
 - b. Reader flashes green on a card read, LED normally red, single line control of LED.
 - c. Reader beeps on a card read, LED normally red, single line control of LED.
 - d. Beeper and LED are controlled by host only, LED normally red, single line control of LED.
 - e. Reader beeps and flashes green on a card read, LED normally off, red and green LED's controlled individually.
 - f. Reader flashes green on a card read, LED normally off, red and green LED's controlled individually.
 - g. Reader beeps on a card read, LED normally off, red and green LED's controlled individually.
 - h. Beeper and LED are controlled by host only, LED normally off, red and green LED controlled individually
 - i. Change from Wiegand to Mag Stripe output format
 - j. Change from Mag Stripe to Wiegand output format
 - k. Reset to Factory Defaults
5. Proximity card readers shall provide the following programmable audio/visual indication:

- a. A piezoelectric sounder shall provide an audible tone upon successful power up/self test, good card read, or whenever the beeper control line is asserted by the host.
 - b. A bi-color, red/green LED shall light upon successful power up/self test, good card read, or whenever the LED control line(s) are asserted by the host.
 - c. The reader shall have individual control lines for the sounder, and for red and green LED indication. When the LED control lines are asserted simultaneously, an amber LED indication will occur.
6. The reader shall have a configurable hold input, which when asserted shall either buffer a single card read or disable the reader, until the line is released. This input may be used for special applications or with loop detectors.
 7. The reader shall require that a card, once read, must be removed from the RF field for one second before it will be read again, to prevent multiple reads from a single card presentation and anti-passback errors.
 8. Typical proximity card read range shall be up to:
 - a. 5.5" (14 cm) using HID Proxcard II card.
 - b. 5" (12.5 cm) using HID ISOProx or DuoProx cards
 - c. 2" (5 cm) using HID ProxKey II key fob
 - d. 2.5" (6.25 cm) using HID Microprox Tag
 - e. 5" (12.5 cm) using HID iCLASS Prox
 - f. 2" (5.0 cm) using HID Prox/Wiegand Card
 9. Proximity card readers shall meet the following physical specifications:
 - a. Dimensions: 6.0 x 1.7 x 1.0" (15.2 x 4.3 x 2.54cm)
 - b. Weight:
 - 1) Terminal Strip: 3.5 oz (99 gm)
 - 2) Pigtail: 3.8 oz (108 gm)
 - c. Material: UL94 Polycarbonate
 - d. Two-part design with separate reader body and cover.
 - e. Color: Black, Gray, White or Beige as approved by the project architect.
 10. Proximity card readers shall meet the following electrical specifications:
 - a. Operating voltage: 5 – 16 VDC, reverse voltage protected. Linear power supply recommended.
 - b. Current requirements: (average/peak) 20/110mA @ 12 VDC
 - c. Proximity card readers shall meet the following certifications:
 - d. UL 294
 - e. Canada/UL 294
 - f. FCC Certification
 - g. Canada Radio Certification
 - h. EU and CB Scheme Electrical Safety
 - i. EU – R&TTE Directive
 - j. CE Mark (Europe)
 - k. C-Tick (Australia)
 - l. New Zealand

- m. Taiwan
 - n. Korea
 - o. China
11. Proximity card readers shall meet the following environmental specifications:
- a. Operating temperature: -22 to 150 degrees F (-30 to 65 degrees C)
 - b. Operating humidity: 0% to 95% relative humidity non-condensing
 - c. Weatherized design suitable to withstand harsh environments The reader shall be of potted, polycarbonate material, sealed to a NEMA rating of 4X (IP55).
12. Proximity card reader cabling requirements shall be:
- a. Cable distance: Wiegand: 500 feet (150m); Clock & Data: 50 feet (15m)
 - b. Cable type: 5-conductor #22 AWG w/overall shield. Additional conductors will be required for 2-line LED control, beeper, hold, or card present functions
 - c. Standard reader termination: 18" (.5m) cable pigtail
 - d. Optional reader termination: 10 screw terminals located under reader cover.
13. Warranty of Proximity card readers shall be lifetime against defects in materials and workmanship.
14. Proximity card reader shall be HID Corporation MiniProx, base P/N 5365 (Wiegand) and 5368 Clock and Data)

2.8 LINE SUPERVISION

- A. Communications between the host computer and the data gathering panels shall be protected against compromise. The system shall detect substitution of resistance or electrical potential, substitution of like equipment, and introduction of synthesized signals. Protective circuits (alarm inputs) shall be protected between the data gathering panel and the sensing devices (door contacts, motion detectors, etc.). Each circuit shall be supervised by end or line resistors located at the sensing device. The system shall detect resistance changes and report alarm and trouble signals at designated values defined by the system manufacturer. The system shall register a minimum of four (4) states: normal, alarm, trouble open (cut), and trouble closed (shorted). Trouble signals shall be displayed to the operator in a format readily identifiable by the operator as a supervisory condition.

2.9 SYSTEM SENSORS AND RELATED EQUIPMENT

- A. The EECS (Electronic Entry Control System) and related Equipment provided by the Contractor shall meet or exceed the following performer specifications:
- B. Request To Exit Detectors:
- 1. The electrified door hardware provided by the Division 8 Door Hardware Contractor shall feature an integrated request to exit device. Electrified door hardware shall be installed by the Division 8 Door Hardware Contractor. The Security Contractor is responsible for performing final terminations to the EECS.

C. Magnetic Contacts

1. Recessed Single Pole Double Throw Door Contact

- a. The door contact shall contain a hermetically sealed magnetic reed switch. The reed shall be potted in the contact housing with a polyurethane based compound. Contact and magnet housing shall snap-lock into a 25.4 mm (1 in) diameter hole. Housing shall be molded of flame retardant abs plastic. Color of housings shall be off-white, grey or mahogany brown. Choice of color to depend on door decor. The contact shall contain a single pole double throw (SPDT) switch with an open or closed loop. Contacts and magnets shall be treated with a thin coat of RTV silicone to hold the contact and magnet in place. Card reader controlled doors, biased and recessed perimeter door contacts, shall be GE model # 1078 or equivalent.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.
- B. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

3.2 CURRENT SITE CONDITIONS

- A. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions which will affect performance of the system to the Owner in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Owner.

3.3 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PREPARATION

- A. Comply with recommendations in SIA CP-01.
- B. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."
- C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval. All forms shall be completed in accordance with specified timelines outlines in Group Technical Data Packages in Section 280500.
 - 1. Record setup data for control station and workstations.
 - 2. For each Location, record setup of Controller features and access requirements.
 - 3. Access Lists
 - 4. Propose start and stop times for time zones and holidays, and match up access levels for doors.
 - 5. Set up groups, facility codes, linking, and list inputs and outputs for each Controller.
 - 6. Assign action message names and compose messages.
 - 7. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
 - 8. Prepare and install alarm graphic maps.
 - 9. Develop user-defined fields.
 - 10. Develop screen layout formats.
 - 11. Propose setups for guard tours and key control.
 - 12. Discuss badge layout options; design badges.
 - 13. Complete system diagnostics and operation verification.
 - 14. Prepare a specific plan for system testing, startup, and demonstration (see the Testing section for requirements).
 - 15. Develop acceptance test concept and, on approval, develop specifics of the test.
 - 16. Develop cable and asset management system details; input data from construction documents. Include system schematics and Visio Technical Drawings.
 - 17. Develop data gathering panel matrices that conform to Section 280500.

- D. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.
- E. All Programming and access lists are submitted, reviewed, and accomplished before any devices are terminated and/or tested.

PART 4 - SYSTEM PROGRAMMING

4.1 REFER TO 280500 PART 4

PART 5 - TESTING AND ACCEPTANCE

5.1 REFER TO 280500 PART 5

END OF SECTION 281300

SECTION 282300 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Refer to 280500 Part 1

1.2 RELATED DOCUMENTS

- A. Refer to 280500 Part 1

1.3 RELATED DIVISION PROVISIONS

- A. Refer to 280500 Part 1

1.4 REFERENCES

- A. Refer to 280500 Part 1

1.5 SUMMARY

- A. This Section includes video management system which consists of cameras, data transmission wiring, and a control station with its associated equipment.
- B. The video surveillance system shall be integrated with monitoring and control system specified in Division 28 Sections "Common Work Results for Electronic Security" and "Access Control" which specifies systems integration.

1.6 DEFINITIONS

- A. Refer to 280500 Part 1

1.7 SUBMITTALS

- A. Refer to 280500 Part 1

1.8 COORDINATION

- A. Refer to 280500 Part 1

1.9 QUALITY ASSURANCE

- A. Refer to 280500 Part 1

1.10 MAINTENANCE & SERVICE

- A. Refer to 280500 Part 1

1.11 SYSTEM DESCRIPTION

- A. The system shall be coordinate with 280500.

1.12 PERFORMANCE REQUIREMENTS

- A. Refer to 280500 Part 1

1.13 DELIVERY HANDLING & STORAGE

- A. Refer to 280500 Part 1

1.14 PROJECT CONDITIONS

- A. Refer to 280500 Part 1

1.15 EQUIPMENT AND MATERIALS

- A. Refer to 280500 Part 1

1.16 ELECTRICAL POWER

- A. Refer to 280500 Part 1

1.17 ENVIRONMENTAL CONDITIONS

- A. Refer to 280500 Part 1

1.18 LIGHTNING, POWER SURGES, & GROUNDING

- A. Refer to 280500 Part 1

1.19 COMPONENT ENCLOSURES

- A. Refer to 280500 Part 1

1.20 ELECTRONIC COMPONENTS

- A. Refer to 280500 Part 1

1.21 SUBSTITUTE MATERIALS & EQUIPMENT

- A. Refer to 280500 Part 1

1.22 LIKE ITEMS

- A. Refer to 280500 Part 1

1.23 WARRANTY

- A. Refer to 280500 Part 1

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The following are acceptable manufacturers of electronic security system products as specified in this specification section. Any proposed product from a different manufacturer is subject to the review procedures in Section 1.05 in this specification.
 - 1. Closed Circuit Television:
 - a. Mobotix
 - 2. Video Recording and Storage:
 - a. Network Attached Storage (NAS) appliance - Owner Provided, Contractor Installed

2.2 VIDEO SURVEILLANCE SYSTEM

- A. The Contractor shall configure the Color CCTV system as specified and shown on the Contract Documents and Drawings. All distances shown are approximate and shall be verified by the Contractor.
- B. The system shall include all interior and exterior housings, mounts, connectors, adapters, and terminations necessary for the interconnection of the video surveillance system. The Contractor shall also supply and install all cabling necessary to interconnect the video equipment installed in the Security Operations Center.
 - 1. The new video system shall consist of all (CMOS) Cameras, Network Attached Storage (Owner Provided, Contractor Installed), and network transmission devices, necessary to integrate with the Owner's existing Video Head-End Equipment.
 - 2. The Video System shall provide operator interface, interaction, control of cameras. The cameras shall continuously view selected locations and/or display operator selections.
- C. Computer Software
 - 1. Video management software is provided by Manufacturer at no additional charge.
 - 2. Contractor is responsible for installing and configuring video management software.

2.3 360° CAMERAS

- A. The 360° Camera shall meet or exceed the following specifications:
 - 1. Lenses L11(hemispheric)
 - 2. Sensitivity Color: 1 lux (t=1/60s), 0.05 lux (t=1/1s)
B/W: 0.1 lux (t=1/60s), 0.005 lux (t=1/1s)

3. Sensor ½" CMOS, progressive scan
4. Max. Image Resolution Color: 2048 x 1536 (3 MEGA)
Black/White: 1280 x 960 (MEGA)
5. Image Format Free image format selection (from 160 x 120 to 2040 x 1536); with L11: PTZ view, Quad view, panorama broad view image, double panorama view, panorama focus with 3 views
6. Max Frame Rate (M-JPEG) (Live/Recording) VGA: 25 fps, TV-PAL: 18 fps, MEGA 8 fps, 3 MEGA: 4 fps
7. Video Stream (MxPEG) (Live/Recording) VGA: 30 fps, TV-PAL: 30 fps, MEGA: 30 fps, 3 MEGA: 20 fps
8. Image Compression MxPEG, M-JPEG, JPEG, H.263 (only Video-VoIP)
9. Internal DVR MicroSD slot (camera-internal video recording up to 32GB)
10. External Storage Directly on NAS and PC/Server without additional recording software
11. Software (Inclusive) Video management software MxEasy, Control room software MxControlCenter
12. Image Processing Backlight compensation, automatic white balance, image distortion correction (panorama image correction included), video sensor (Motion Detection)
13. Virtual PTZ Digital Pan/Tilt/Zoom, continuous 8x zoom
14. Alarm/Events Triggering of events by integrated multiple-window motion detection, temperature sensor, notification over email, FTP, IP telephony (VoIP, SIP), visual/acoustic alarm, pre-and post alarm images
15. Audio Integrated microphone and speaker, lip-synchronous audio, two-way speaker, audio recording
16. Interfaces Ethernet 10/100, USB, MxBus
17. Video Phone VoIP, SIP, two-way speaker, remote control via DTMF signaling, event notification
18. Security User-/Group management, HTTPS/SSL, IP address filter, IEEE 802.1x, intrusion detection, digital image signature
19. Certificates EMC (EN50121-4, EN55022, EN55024, EN61000-6-2, FCC part 15B, AS.NZS3548)
20. Power Supply Power over Ethernet (802.3af):

PoE class variable depending on operating mode;
power consumption; typ. 3W; with PoE
switch/MOBOTIX PoE – Adapter

- 21. Operating Conditions IP65 (DIN EN 60529), -30 to +60 °C (-22 to +140 °F)
- 22. Dimensions \varnothing x H: 16 x 5 cm, weight: ca. 450 g
- 23. Standard Delivery Housing (high resistance composites – PBT-PC), white, incl. 360° lens, mounting parts, allen wrench patch cable – 50cm, manual, software, 4 GB Micro SD (except Basic)

- B. 360° Camera shall be the Q24 Hemispheric camera by Mobotix, or Owner approved equal.
- C. The Contractor shall provide camera mounts and mounting hardware as described in the Contract Documents.
- D. Contractor shall coordinate all camera views with the Owner prior to procuring cameras and camera lenses. Contractor responsible for performing all calculations necessary to provide optimal camera images in accordance with Owner's guidance. All camera images must be verified by the Owner or Owner's representative prior to final adjustment.

2.4 SINGLE VIEW FIXED DOME CAMERA

- A. The Single View Fixed Dome Camera shall meet or exceed the following specifications:

- 1. Lenses 22 to 135 mm format,
Horizontal angle 90° to 15°
- 2. Sensitivity Color: 1 lux (t=1/60s), 0.05 lux (t=1/1s)
B/W: 0.1 lux (t=1/60s), 0.005 lux (t=1/1s)
- 3. Sensor 1/2" CMOS, progressive scan
- 4. Max. Image Resolution Color: 2048 x 1536 (3 MEGA)
Black/White: 1280 x 960 (MEGA)
- 5. Image Format 2048 x 1536, 1280 x 960, 1024 x 768, 800 x 600,
768 x 576 (D1), 704 x 576 (TV-PAL), 640 x 480,
384 x 288, 352 x 288, 320 x 240, 160 x 120; free
image format selection (e.g. 1000 x 200 for skyline)
- 6. Max Frame Rate (M-JPEG) (Live/Recording) VGA: 25 fps, TV-PAL: 18 fps, MEGA 8 fps,
3MEGA: 4 fps
- 7. Video Stream (MxPEG) (Live/Recording) VGA: 30 fps, TV-PAL: 30 fps, MEGA: 30 fps,
3MEGA: 20 fps
- 8. Image Compression MxPEG, M-JPEG, JPEG, H.263 (only Video-VoIP)
- 9. Internal DVR MicroSD slot (camera-internal video recording up to
32GB)

- | | |
|--------------------------|---|
| 10. External Storage | Directly on NAS and PC/Server without additional recording software |
| 11. Software (Inclusive) | Video management software MxEasy, Control room software MxControlCenter |
| 12. Image Processing | Backlight compensation, automatic white balance, image distortion correction |
| 13. Virtual PTZ | Digital Pan/Tilt/Zoom, continuous 8x zoom |
| 14. Alarm/Events | Triggering of events by integrated multiple-window motion detection, temperature sensor, notification over email, FTP, IP telephony (VoIP, SIP), visual/acoustic alarm, pre-and post alarm images |
| 15. Audio | Optional via ExtI/O, lip-synchronous audio, two-way speaker, audio recording, video VoIP supported |
| 16. Interfaces | Ethernet 10/100, USB, MxBus |
| 17. Video Phone | VoIP, SIP, two-way speaker, remote control via DTMF signaling, event notification |
| 18. Security | User-/Group management, HTTPS/SSL, IP address filter, IEEE 802.1x, intrusion detection, digital image signature |
| 19. Certificates | EMC (EN50121-4, EN55022, EN55024, EN61000-6-2, FCC part 15B, AS.NZS3548) |
| 20. Power Supply | Power over Ethernet (802.3af):
PoE class variable depending on operating mode; power consumption; typ. 3W; with PoE switch/MOBOTIX PoE – Adapter |
| 21. Operating Conditions | IP65 (DIN EN 60529), -30 to +60 °C (-22 to +140 °F) |
| 22. Dimensions | ∅ x H: 16 x 8.6 cm, weight: ca. 350 g |
| 23. Standard Delivery | Housing (high-resistance composites – PBT), white, shockproof polycarbonate dome (transparent), free choice of lenses, mounting parts, allen wrench, patch cable – 50cm, manual, software, 4 GB Micro SD (except Basic) |
- B. Fixed Dome Camera shall be the D24 MonoDome by Mobotix, or Owner approved equal.
- C. The Contractor shall provide camera mounts and mounting hardware as described in the Contract Documents.
- D. Contractor shall coordinate all camera views with the Owner prior to procuring cameras and camera lenses. Contractor responsible for performing all calculations necessary to provide

optimal camera images in accordance with Owner's guidance. All camera images must be verified by the Owner or Owner's representative prior to final adjustment.

2.5 DUAL VIEW FIXED DOME CAMERA

A. The Dual View Fixed Dome Camera shall meet or exceed the following specifications:

- | | |
|--|---|
| 1. Lenses | 22 to 135mm format
Horizontal angel 90° to 15 ° |
| 2. Sensitivity | Color: 1 lux (t=1/60s), 0.05 lux (t=1/1s)
B/W: 0.1 lux (t=1/60s), 0.005 lux (t=1/1s) |
| 3. Sensors | 2 x 1/2" CMOS, progressive scan |
| 4. Max. Image Resolution | Color: 2048 x 1536 (3 MEGA)
Black/White: 1280 x 960 (MEGA) |
| 5. Image Format | 2048 x 1536, 1280 x 960, 1024 x 768, 800 x 600,
768 x 576 (D1), 704 x 576 (TV-PAL), 640 x 480,
384 x 288, 352 x 288, 320 x 240, 160 x 120; free
image format selection (e.g. 1000 x 200 for skyline) |
| 6. Max Frame Rate
(M-JPEG) (Live/Recording) | VGA: 16 fps, TV-PAL: 12 fps, MEGA 6 fps,
3MEGA: 4 fps |
| 7. Video Stream (MxPEG)
(Live/Recording) | VGA: 30 fps, TV-PAL: 24 fps, MEGA: 14 fps,
3MEGA: 10 fps |
| 1. Image Compression | MxPEG, M-JPEG, JPEG, H.263 (only Video-VoIP) |
| 2. Internal DVR | SD slot (up to 32GB), 16GB internal (Sec-R16) |
| 3. External Storage | Directly on NAS and PC/Server without additional
recording software |
| 4. Software (Inclusive) | Video management software MxEasy, Control room
software MxControlCenter |
| 5. Image Processing | Backlight compensation, automatic white balance,
image distortion correction, video sensor (motion
detection) |
| 6. Virtual PTZ | Digital Pan/Tilt/Zoom, continuous 8x zoom |
| 7. Alarm/Events | Triggering of events by integrated multiple-window
motion detection, temperature sensor, notification
over email, FTP, IP telephony (VoIP, SIP),
visual/acoustic alarm, pre-and post alarm images |
| 8. Audio | Integrated microphone and speaker, Line-In/Line-
Out, lip-synchronous audio, two-way speaker, audio
recording |

- | | | |
|-----|----------------------|---|
| 9. | Interfaces | Ethernet 10/100, ISDN, RS232, 3 x In, 1 x Out |
| 10. | Video Phone | VoIP, SIP, two-way speaker, remote control via DTMF signaling, event notification |
| 11. | Security | User-/Group management, HTTPS/SSL, IP address filter, IEEE 802.1x, intrusion detection, digital image signature |
| 12. | Certificates | EMC (EN55022, EN55024, EN61000-6-2, FCC part 15B, AS.NZS3548) |
| 13. | Power Supply | Power over Ethernet (802.3af; Class 0), Netpower-Adapter, typ. 4W |
| 14. | Operating Conditions | IP54/IP65 (without/with wall mount), -30 to +60 °C (-22 to +140 °F) |
| 15. | Dimensions | Ø x H: 20.1 x 11 cm, weight: ca. 650 g |
| 16. | Standard Delivery | Housing (high-resistance composites – PBT), white, shockproof polycarbonate dome (transparent), free choice of lenses, mounting parts, allen wrench, patch cable – 50cm, manual, software, 4 GB Micro SD (except Basic) |
- B. Dual View Fixed Dome Camera shall be the D12 DualDome by Mobotix, or Owner approved equal.
- C. The Contractor shall provide camera mounts and mounting hardware as described in the Contract Documents.
- D. Contractor shall coordinate all camera views with the Owner prior to procuring cameras and camera lenses. Contractor responsible for performing all calculations necessary to provide optimal camera images in accordance with Owner's guidance. All camera images must be verified by the Owner or Owner's representative prior to final adjustment.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install all system components and appurtenances in accordance with the manufacturer's instructions, ANSI C2, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.
 - 1. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.
 - 2. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.
- B. Current Site Conditions: The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Owner in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Owner.
- C. Conduit and Wire: Refer to 280513 – Conductors and Cables for Electronic Security

3.2 CLOSED CIRCUIT TELEVISION

- A. Installation: The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2, and shall furnish all necessary connectors, terminators, interconnections, services, adjustments and licenses required for a complete and operable video system.
- B. Interconnection Video Equipment: The Controller shall connect signal paths between video equipment of 250' or less with Cat 6 cable. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack.
- C. Cameras: The Contractor shall install the cameras with the proper focal length lens as indicated for each zone; connect power and signal lines to the camera; set cameras with fixed iris lenses to the proper f-stop to give full video level; aim camera to give field of view as needed to cover the alarm zone; aim fixed mount cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun; focus the lens to give a sharp picture over the entire field of view; and synchronize all cameras so the picture does not roll on the monitor when cameras are selected.

- D. Video Recording Equipment: The Contractor shall install the video recording equipment as shown and as specified by the manufacturer; connect video signal inputs and outputs as shown and specified; connect alarm signal inputs and outputs as shown and specified; and connect video recording equipment to AC power.
- E. Video Signal Equipment: The Contractor shall install the video signal equipment as specified by the manufacturer and as shown; connect video or signal inputs and outputs as shown and specified; terminate video inputs as required; connect alarm signal inputs and outputs as required; connect control signal inputs and outputs as required; and connect electrically powered equipment to AC power.
- F. System Start Up: The Contractor shall not apply power to the CCTV system until the following items have been completed:
 - 1. CCTV system equipment items and DTM have been set up in accordance with manufacturer's instructions.
 - 2. A visual inspection of the CCTV system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
 - 3. System wiring has been tested and verified as correctly connected as indicated.
 - 4. All system grounding and transient protection systems have been verified as properly installed and connected as indicated.
 - 5. Power supplies to be connected to the system have been verified as the correct voltage, phasing, and frequency as indicated.
 - 6. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.3 WIRELINE DATA TRANSMISSION

- A. Installation: The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable data transmission system.
- B. Identification and Labeling: The Contractor shall supply permanent identification labels for each cable at each end that will appear on the as-built drawings. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified by type or signal being carried and termination points. The labels shall be printed on letter size label sheets that are self laminated vinyl that can be printed from a computer data base or spread sheet. The labels shall be E-Z code WES12112 or equivalent.
 - 1. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.
- C. Transient Voltage Surge Suppressors (TVSS): The Contractor shall mount TVSS within 3 m (118 in) of equipment to be protected inside terminal cabinets or suitable NEMA 1 enclosures. Terminate off-premise conductors on input side of device. Connect the output side of the

device to the equipment to be protected. Connect ground lug to a low impedance earth ground (less than 10 ohms) via Number 12 AWG insulated, stranded copper conductor.

- D. Contractor's Field Test: The Contractor shall verify the complete operation of the data transmission system during the Contractor's Field Testing. Field test shall include a bit error rate test. The Contractor shall perform the test by sending a minimum of 1,000,000 bits of data on each DTM circuit and measuring the bit error rate. The bit error rate shall not be greater than one (1) bit out of each 100,000 bits sent for each dial-up DTM circuit, and one (1) bit out of 1,000,000 bits sent for each leased or private DTM circuit. The Contractor shall submit a report containing results of the field test.
- E. Acceptance Test and Endurance Test: The wire line data transmission system shall be tested as a part of the completed IDS and EECS during the Acceptance test and Endurance Test as specified.
- F. Identification and Labeling: The Contractor shall supply identification tags or labels for each cable. Cable shall be labeled at both end points and at intermediate hand holes, manholes, and junction boxes. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

3.4 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install cameras level and plumb.
- B. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Identification of Electrical Systems."

3.5 PROGRAMMING

- A. Refer to 280500, Part 3

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation and supervise pretesting, testing, and adjusting of video surveillance equipment.
- B. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
- C. Pretesting: Refer to 280500, Part V

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions and to

optimize performance of the installed equipment. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
3. Adjust all preset positions; consult Owner's personnel.
4. Recommend changes to cameras, lenses, and associated equipment to improve Owner' utilization of video surveillance system.
5. Provide a written report of adjustments and recommendations.

3.8 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video surveillance system components, including camera-housing windows, lenses, and monitor screens.

PART 4 - SYSTEM PROGRAMMING

4.1 REFER TO 280500 PART 4

PART 5 - TESTING AND ACCEPTANCE

5.1 REFER TO 280500 PART 5

END OF SECTION 282300

SECTION 283111

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Fire Alarm Control Panel (FACP)
 2. Storage Batteries.
 3. Battery Charger.
 4. Cabinet.
 5. Manual Pull Station.
 6. Addressable Interface Devices.
 7. Terminal Cabinets/Assemblies.
 8. Addressable Relays.
 9. Annunciator Panel(s).
 10. Speaker/Strobe Unit.
 11. Fire Alarm Speaker.
 12. Visual Alarm Signal Strobe.
 13. Smoke Detector.
 14. Duct Smoke Detector.
 15. Heat Detector.
 16. Amplifiers.
 17. Tone Generators.
 18. Digitalized Voice Generators.
 19. Notification Appliance Extender Panel
 20. System Printer
 21. All wiring types and sizes.
- B. Related Sections include the following:
 1. Division 21 Section "COMMON WORK RESULTS FOR FIRE SUPPRESSION".
 2. Division 21 Section "WATER-BASED FIRE-SUPPRESSION SYSTEMS".
 3. Division 21 Section "CONTROLLERS FOR FIRE-PUMP DRIVERS".

1.3 APPLICABLE PUBLICATIONS

- A. General: Provide a digital, addressable voice communication fire alarm system conforming to the requirements of the latest edition of the following publications including all amendments to these publications:

1. American Society for Testing and Materials (ASTM):
 - a. E-84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - b. E-119 Standard Test Method for Fire Tests of Building Construction and Materials.
2. American Society of Mechanical Engineers (ANSI/ASME):
 - a. A17.1 Safety Code for Elevators and Escalators.
 - b. C62.41 Guide for Surge Voltages in Low Voltage A.C. Power Circuits
3. International Code Council (ICC):
 - a. International Building Code, 2009 Edition.
 - b. International Mechanical Code, 2009 Edition.
4. Montgomery County Department of Permitting Services (DPS):
 - a. Building Construction Standards
5. National Fire Protection Association (NFPA):
 - a. 70 National Electric Code, 2008 Edition
 - b. 72 National Fire Alarm Code, 2007 Edition.
 - c. 13 Standard for the Installation of Sprinkler Systems, 2007 Edition.
 - d. 14 Standard for the Installation of Standpipe Systems, 2007 Edition.
 - e. 20 Standard for the Installation of Stationary Pumps for Fire Protection, 2007 Edition.
 - f. 1 Uniform Fire Code, 2009 Edition
6. Americans With Disabilities Act (ADA)
7. Testing Services or Laboratories: Construct all fire alarm and fire detection equipment in accordance with the latest edition of all applicable publications from Underwriters Laboratories Inc. (UL), or Factory Mutual Engineering Corporation (FM).

1.4 DEFINITIONS

- A. General: Wherever mentioned in this specification or on the drawings the equipment, devices, and functions shall be defined as follows:
 1. Alarm Signal: A signal which indicates a state of emergency requiring immediate notification of the fire department and of the building occupants. These are signals such as the operation of a manual pull station, the activation of a waterflow switch in a sprinkler system, the receipt of an alarm signal from a smoke detector that has gone through alarm verification, the receipt of an alarm signal from an elevator smoke detection control panel or a computer room smoke detection control panel, the operation of a duct smoke detector, the operation of a heat detector, or the operation of a pressure switch in a fire suppression system caused by the flow of fire extinguishing agent (e.g. kitchen fire extinguishing system, CO2, ect.).

2. Supervisory Signal: A signal which indicates the impairment of a fire protection system which may prevent its normal use. These are signals from switches, such as a tamper switch; a low and/or high air pressure switch.
3. Trouble Signal: A signal which indicates that a fault, such as an open circuit or ground, has occurred in the fire alarm system or in a separate sub-system, whose control panel is monitored by the fire alarm system.
4. Addressable System: A system in which multiple signals are transmitted via the same conduction path to a remote fire alarm control unit and the fire alarm control panel, decoded and separated so that each signal will initiate the specified response.
5. Notification Appliance Circuit: A circuit or path directly connected to a notification appliance(s).
6. Notification Appliance: A fire alarm system component such as a bell, horn, light, speaker, or text display that provides audible, visual, or tactile outputs, or any combination thereof.
7. Interface Device: An addressable device which interconnects hard wired systems or devices to an analog system.
8. Fire Alarm Control Panel (FACP): A control panel having the features of a fire alarm control unit and to which all fire alarm control units are interconnected. The panel has central processing, memory, input and output terminals, video display units and printers.
9. Class A Wiring: A circuit that is monitored for integrity such that a single break, a single wire-to-wire short, or a single loss of carrier condition will be indicated by a trouble signal on the FACP no matter where the break, short or loss of carrier conditions occurs and will allow all functions of the affected circuit to remain operational.
10. Class B Wiring: A circuit that is monitored for integrity such that a single break, a single wire-to-wire short, or a single loss of carrier condition will be indicated by a trouble signal on the FACP no matter where the break, short or loss of carrier conditions occurs but which would prohibit devices beyond the fault, short or carrier loss from remaining operational. In accordance with NFPA 72, this would be style 4 wiring for signaling line circuits, style B for initiating device circuits, and style Y for notification appliance circuits.
11. Spare capacity: Each circuit must be able to handle the actual number of devices installed plus that number times the spare capacity.
12. Signaling Line Circuit: A circuit to which any combination of circuit interfaces, control units, or transmitters are connected and over which multiple system input signals or output signals, or both are carried.
13. Manual Pull Stations: A fire alarm box as indicated in NFPA 72.
14. Tamper Switch: A valve monitor switch as indicated in NFPA 72.
15. Initiating Device: A system component that originates transmission of a change of state condition, which initiates an appropriate response via the fire alarm system.
16. Terminal Cabinet: A steel cabinet with locking, hinge-mounted door in which terminal strips are securely mounted. Minimum size is 12 x 12 inches.

1.5 SYSTEM DESCRIPTION

- A. General: This specification intends to describe an integrated fire detection and voice evacuation system to be intelligent device addressable, analog detecting, low voltage and modular with multiplex communication techniques in full compliance with all applicable codes and standards. The features described in this specification are a requirement for this project and shall be furnished by the successful contractor.

- B. Extent of the Work: The system shall be installed in accordance with the drawings, specifications and referenced publications.
- C. Repair Service/Replacement Parts: On-site service during the guarantee period shall be provided within 24-hours after notification. All repairs shall be completed within 48-hours after notification. Repair services and replacement parts for the system shall be furnished under this contract and be available for a period of 10-years after the date of final acceptance of this work by the owner. After the initial guarantee period, replacement parts shall be provided within 48-hours of the request.
- D. Megger Test: Megger test results must be submitted to the Owner's Representative prior to installing any field devices.

1.6 SYSTEM OPERATION

- A. General: System shall be a complete, new, supervised, noncoded, digital, addressable voice communication fire alarm system for Science West, conforming to NFPA 72, City of Rockville and listed under UL 864 9th edition. Any single impairment of the system initiating or notification appliance circuits shall not affect the system on more than one-half of any floor. This can be accomplished with either class A or class B wiring. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal. The maximum time for the panel to reset after the reset switch is operated is 90-seconds. The system shall provide the following functions and operating features:
 - 1. The FACP and other fire alarm control units shall provide power, annunciation, supervision, and control for the system.
 - 2. Provide Class B initiating device circuits, signaling line circuits, and notification appliance circuits, unless otherwise noted.
 - 3. Provide Pathway Survivability Level 1 for building that is fully sprinklered.
 - 4. Provide Class A supervision for the high and low level audio riser and the tone generators to amplifiers.
 - 5. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
 - 6. Provide an audible and visual trouble signal to activate upon a single break or open condition, or ground fault which prevents the required operation of the system. The trouble signal shall also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, or removal of alarm or supervisory panel modules. Provide a trouble alarm silence feature which will silence the audible trouble signal, without affecting the visual indicator. After the system returns to normal operating conditions, the trouble signal shall again sound until the trouble is acknowledged. A smoke detector in the process of being verified for the actual presence of smoke shall not initiate a trouble condition.
 - 7. Provide a notification appliance silencing switch which, when activated, will cause the notification appliances to cease operating, but not affect the liquid crystal display or the automatic notification of the central station monitoring center. The activation of the silencing switch shall not cause the strobe lights to cease operation. This switch shall be overridden upon activation of a subsequent alarm.
 - 8. Provide alarm verification for all smoke detectors.

9. Provide a single disable point to bypass all of the following functions: the automatic notification appliance circuits, strobe lights, air handler shutdown, elevator recall, elevator shunt trip, door release and door unlocking features. Operation of the button or switch shall indicate this action on the FACP display and printer output and shall cause a system trouble.
10. All alarm, supervisory, or trouble signals shall be automatically transmitted to the central station monitoring center.
11. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
12. The system shall be capable of being programmed in the field. All program information shall be stored in non-volatile memory.
13. The system shall be capable of operating, supervising, and/or monitoring both addressable and non-addressable alarm and supervisory devices.
14. There shall be no limit, other than maximum system capacity, as to the number of addressable devices which may be in alarm simultaneously.
15. Where the fire alarm system is responsible for initiating an action in another emergency control device or system, such as an HVAC system, elevator system, or door releasing service, the addressable fire alarm relay shall be within 3-feet of the emergency control device or fail-safe power supply / control circuit.
16. An alarm signal shall automatically initiate the following functions:
 - a. Transmission of an alarm signal to a UL listed central station monitoring center.
 - b. Visual indication that the device operated on the fire alarm control panel (FACP) and on the remote LCD annunciator.
 - c. Release of power to electric locks on doors which are part of the means of egress via a signal to the security/access control system.
 - d. Operation of a smoke detector in an elevator lobby or other location associated with the automatic recall of elevators, shall recall the elevators in addition to a,b and c above.
 - e. Operation of a smoke detector adjacent to the pedestrian walkway fire shutter shall close the pedestrian walkway shutter on hold-open hardware via addressable relay interruption of the hold-open power supply in addition to a,b and c above.
 - f. Operation of a duct smoke detector shall shut down the appropriate air handler in accordance with the International Mechanical Code.
 - g. Operation of a heat detector in or serving an elevator machinery room or elevator shaft shall operate shunt trip circuit breaker(s) to shut down power to the elevators served by the elevator machine room in accordance with ANSI A17.1 in addition to a,b,c, and d above.
17. A supervisory signal shall automatically initiate the following functions:
 - a. Transmission of a supervisory signal to the central station monitoring center.
 - b. Visual indication of the device operated on the FACP and on the remote LCD annunciator.
18. A trouble condition shall automatically initiate the following functions:
 - a. Transmission of a trouble signal to the central station monitoring center.
 - b. Visual indication of the system trouble on the FACP and on the remote LCD annunciator.

1.7 SYSTEM MONITORING

- A. Valves: Each valve affecting the proper operation of a fire protection system, including automatic sprinkler control valves, fire pump control and by-pass valves, sprinkler service

entrance valve, and valves at backflow preventers shall be monitored to ensure its proper positions. Each tamper switch shall be provided with a separate address.

1.8 SUBMITTALS

- A. General: Refer to division 1 for basic information relating to submittal requirements. Submit six complete sets of submittals, including shop drawings, material data sheets and calculations. Partial submittals will not be acceptable and will be returned without review. Before any work is commenced, the submittal must be approved by the owner's representative, Authority Having Jurisdiction (AHJ), and Elevator Inspector. Manufacturer's data shall be annotated and provided for the following items at a minimum, but not limited to:
1. Fire Alarm Control Panel (FACP) (Including printers, covers, console rack, ect.)
 2. Storage Batteries.
 3. Battery Charger.
 4. Cabinet.
 5. Manual Pull Station.
 6. Addressable Interface Devices.
 7. Terminal Cabinets/Assemblies.
 8. Addressable Relays.
 9. Annunciator Panel(s).
 10. Speaker/Strobe Unit.
 11. Fire Alarm Speaker.
 12. Visual Alarm Signal Strobe.
 13. Smoke Detector.
 14. Duct Smoke Detector.
 15. Heat Detector.
 16. Amplifiers.
 17. Tone Generators.
 18. Digitalized Voice Generators.
 19. Notification Appliance Extender Panel
 20. All wiring types and sizes.
- B. Submittal Requirements:
1. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET III-certified fire-alarm technician
- C. Product Data: For each type of product indicated.
- D. Final Fire Alarm Program: Provide two (2) disk copies of the fire alarm program as part of the as-built submittals. These disks shall be submitted within 2-weeks after the final acceptance test of the system.
- E. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
1. Drawings shall be prepared on uniform sized sheets not less than 30 by 42 inches.

2. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 3. Provide a complete list of device addresses and corresponding messages.
 4. Provide a detailed drawing of the graphic panel.
 5. Include annotated catalog data showing manufacturer's name, model, voltage, and catalog number for all equipment and components.
 6. Provide data on each circuit to indicate that there is at least 20-percent spare capacity for initiating devices and modules.
 7. Provide data to indicate that the amplifiers have sufficient capacity to simultaneously drive all fire alarm speakers at their 1/2-watt tap setting plus 20-percent spare capacity.
 8. Include voltage drop calculations for notification appliance circuits.
 9. Include battery-size calculations.
 10. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 11. Provide plans, sections, elevations, and risers of fire alarm system including coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 12. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
 14. Include riser diagram.
 15. Include system sequence of operation.
- F. Qualification Data: For NICET qualified Installer.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Record copy of site-specific software.
 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 5. Manufacturer's required maintenance related to system warranty requirements.
 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 7. Copy of NFPA 72.

I. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup:
3. Device address list.
4. Printout of software application and graphic screens if applicable.

1.9 INSTRUCTION OF COLLEGE EMPLOYEES

- A. Instructor: Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided. The instructor shall train the employees designated by the owner, in the care, adjustment, maintenance, and operation of the fire alarm and fire detection system.
- B. Qualifications: Each instructor shall be thoroughly familiar with all parts of this installation. The instructor shall be trained in operating theory, as well as in practical operation and maintenance work.
- C. Required Instruction Time: Provide 16-hours of instruction after initial acceptance of the system. The instruction shall be given during regular working hours on such dates and times selected by the owner. The instruction may be divided into two or more periods at the discretion of the owner.

1.10 QUALITY ASSURANCE

- A. System Supplier and Installer Requirements: Shop drawing design shall be by a NICET level III or IV fire alarm technician or a registered fire protection engineer. System distributor and electrical contractor shall have offices, which have been in existence for at least 3-years, within a 75-mile radius of the project site. Installations shall be accomplished by an electrical contractor with a minimum of 5-years experience in the installation of fire alarm systems. The owner's representative may reject and proposed installer who cannot show evidence of such qualifications. The services of a technician provided by the control equipment manufacturer shall be provided to supervise installation, adjustments, and tests of the system.
- B. Source Limitations for Fire-Alarm System and Components: Components shall be sole sourced from and compatible with a Simplex Grinnell manufactured system.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Provide design, materials and devices for a protected premises fire alarm system, complete, conforming to National Fire Protection Association Standard 72, except as otherwise or additionally specified herein.
- E. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.11 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864 9th edition.
 - 1. Technical Support: Shall be provided for 2 years from the date of substantial completion.

1.12 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Quantity equal to 2 percent but no fewer than 1 unit of all devices as required by owner's representative.

1.13 WARRANTY

- A. Service Organization: The contractor shall furnish evidence that the fire alarm equipment supplier has an experienced and effective service organization which carries a stock of repair parts for the system to be furnished. Should the contractor fail to comply with the service requirements of this section, the owner will then have the option to make the necessary repairs and back charge the contractor without any loss of warranty or guarantee as provided by the contract documents.
- B. Guarantee: The contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of 2-years after the date of final acceptance of this work by the owner and the receipt of as-built drawings and schematics of all equipment. The guarantee period begins when all defects and omissions have been corrected and the owner's representative has confirmed that these items have been corrected.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: The system components, other than general electrical equipment, wiring and tubing, shall be manufactured by Simplex Grinnell.

2.2 SYSTEM SEQUENCE OF OPERATIONS

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors
 - 4. Automatic sprinkler system water flow.
 - 5. Heat detectors in elevator shaft, pit and machine room.
 - 6. Fire suppression system-activation monitoring devices.

B. Fire-alarm signal shall initiate the following actions (except duct smokes, supervisory devices):

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote LCD/Graphic floor plan annunciator.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Close doors and shutters utilizing hold-open hardware (Pedestrian Walkway fire shutter associated detectors only)
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode (or shutdown).
8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
9. Recall elevators to primary or alternate recall floors.
10. Record events in the system memory.
11. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Elevator shunt-trip supervision.
3. Duct smoke detectors.
4. Loss of power to the fire pump.
5. Phase reversal on the fire pump.
6. Single Phase Condition.
7. Fire Pump Fault/Trouble.
8. Fire Pump Running.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote LCD annunciator. Record the event on system printer.

2.3 MANUAL PULL STATIONS

A. Manufacturer and Model Requirements: Simplex, double action, push operation addressable manual stations.

1. General Requirements: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If surface mount needed, provide manufacturer's surface back box.

- B. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.
- C. Provide metal or plastic, semi-flush mounted, double action, addressable manual stations, which are not subject to operation by jarring or vibration. Stations shall be equipped with screw terminals for each conductor. Stations which require the replacement of any portion of the device after activation are not permitted. Stations shall be finished in red with molded raised lettering operating instructions of contrasting colors. The use of a key or wrench shall be required to reset the station.

2.4 ADDRESSABLE INTERFACE DEVICE

- A. The addressable interface (AI) device shall provide an addressable input interface to the FACP for monitoring normally-open or normally-closed contact devices such as waterflow switches, valve supervisory switches, relays for output function actuation, ect. Provide a separate address for each device.
- B. Provide single pole, double throw, relays for fire alarm output functions.

2.5 NOTIFICATION APPLIANCES

- A. Visible Notification Appliances:
 - 1. Provide strobe light visual alarm signals which operate on a supervised 24-volt DC circuit. The strobe lens shall comply with UL 1971 and conform to the Americans with Disabilities Act. The light pattern shall be disbursed so that it is visible above and below the strobe and from a 90-degree angle on both sides of the strobe. Provide clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" shall be engraved in minimum 1-inch- (25-mm-) high letters on the lens. The rated light output shall be 15/30/75/110 cd selectable in the field.
- B. Voice/Tone Notification Appliances:
 - 1. Manufacturer and Model Requirement: Simplex audible notification appliances
 - 2. Provide fire alarm speakers conforming to UL 464 having a minimum of three (3) tap settings and separate terminations for each "in" and "out" connection. Tap settings shall include taps of 1/4, 1/2, 1, and 2-watt. Speakers shall utilize the 1/2-watt tap in the system. Speakers shall have a minimum rating of 84 dBA at 10-feet as determined by the reverberant room test; data on peak output as determined in an anechoic chamber is not suitable. All speakers shall be capable of installation on standard 4-inch square electrical boxes. Where speakers and strobes are provided in the same location, they may be combined into a single wall mounted unit.
 - 3. Provide speaker mounting plates constructed of cold rolled steel having a minimum thickness of 16-gauge and equipped with mounting holes and other openings as needed for a complete installation. All fabrication marks and holes shall be ground and finished to

provide a smooth and neat appearance for each plate. Each plate shall be primed and painted.

4. Low-Range Units: Rated $\frac{1}{4}$ W to 2 W.
5. Microphone for manual page functions stored in a cabinet adjacent to fire-alarm control unit

2.6 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. All Simplex detectors will use the Simplex sensor base (verify bases required for frame mounting are utilized where indicated on contract drawings).

B. Photoelectric Smoke Detectors:

1. Manufacturer and Model Requirement: Simplex, Photoelectric sensor.
2. Provide self restoring type detectors which do not require any readjustment after actuation to restore them to normal operation. Detectors shall be UL listed as smoke-automatic fire detectors.
3. All components shall be rust and corrosion resistant. Vibration shall have no effect on the detector's operation. Protect the detection chamber with fine mesh metallic screen which prevents the entrance of insects or airborne materials. The screen shall not inhibit the movement of smoke particles into the chamber.
4. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
5. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Manufacturer and Model Requirement: Simplex, photoelectric sensor mounted on Simplex base with local relay or separate relay engaged through fire-alarm control unit programmable output.
2. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

3. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
4. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
5. Each sensor shall have multiple levels of detection sensitivity.
6. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
7. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.7 HEAT DETECTORS

- A. Manufacturer and Model Requirement: Simplex, heat sensor mounted on Simplex sensor base.
- B. General Requirements for Heat Detectors: Comply with UL 521.

2.8 VALVE MONITOR (TAMPER) SWITCHES:

- A. General: Connect tamper switches provided under division 21 Section "Water-Based Fire Suppression Systems" into the fire alarm.

2.9 WATERFLOW DETECTORS:

- A. General: Connect waterflow detectors provided under division 21 Section "WATER-BASED FIRE-SUPPRESSION SYSTEMS" into the fire alarm system.

2.10 FIRE ALARM CONTROL PANEL (FACP)

- A. Manufacturer and Model Requirement: Simplex 4100U series digital, addressable network detection and control system with a Simplex BACpac Portal for BACnet communication with the Building Automation System.
- B. General: Provide a complete control panel fully enclosed in a lockable steel enclosure as specified herein. The unit shall be a field-programmable, microprocessor-based, power limited design with electronic modules, complying with UL 864 9th edition and listed and labeled by an NRTL. All operations required for testing or for normal care and maintenance of the systems shall be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control panel, the unit enclosures shall match exactly. Each control unit shall provide power, supervision, control and logic for the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit shall be suitable for operation on a 120-volt, 60-Hz, normal building power supply. Provide each

panel with supervisory functions for power failure, internal component placement, and operation. Visual identification of alarm, supervisory or trouble initiation on the fire alarm control panel shall be by liquid crystal display or similar means with a minimum of 80 characters of which at least 32 are field changeable.

- C. Cabinet: Install control panel components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of all panels as well as all field wiring. The enclosure shall be identified by an engraved laminated phenolic resin nameplate. Lettering on the nameplate shall say FACP and shall not be less than 1-inch. Provide prominent rigid plastic or metal identification plates for all lamps, circuits, meters, fuses and switches. The cabinet shall be provided in a sturdy steel housing, complete with backbox, hinged steel door with cylinder lock, and surface mounting provisions. Provide 20-percent spare space in cabinet backbox for future expansion.
- D. Control Modules: Provide power and control modules to perform all functions of the FACP. Provide audible signals to indicate any alarm or trouble condition. The alarm signals shall be different from the trouble signal. Connect all circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and relays, if any, on screw terminals in the FACP. Circuits operating at 24-volts DC shall not operate at less than 20.4-volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 15-percent of nominal voltage.
- E. Silencing Switches: Provide an alarm silence switch at the FACP which will silence the audible signal but not affect the visual alarm indicator. Provide trouble and supervisory silencing switch which will silence the audible trouble and supervisory signal, but not extinguish the visual indicator. This switch shall be overridden upon the activation of a subsequent alarm.
- F. By-Pass Switches: Provide switches at the FACP which will bypass the automatic notification appliance circuits, strobe lights, air handler shutdown, elevator recall, elevator shunt trip.
- G. Non-Interfering: Power and supervise each circuit such that a signal from one device does not prevent the receipt or transmission of signals from any other device. All circuits shall be manually resettable by switch from the FACP after the initiating device or devices have been restored to normal.
- H. Fire Alarm Message: A fire alarm shall activate the standard fire alarm signal, a three pulse temporal pattern using any appropriate sound, in accordance with ANSI S3.41, for three cycles followed message which is repeated until the control panel is reset. Automatic messages shall be broadcast through speakers on all floors. A live voice message shall override the automatic output through the use of a microphone input at the control panel. When using the microphone, live messages shall be broadcast throughout selected floors. The system shall be capable of operating all speakers at the same time. The digitalized voice message shall consist of a non-volatile (EPROM) microprocessor based input to the amplifiers. The microprocessor shall actively interrogate all circuitry, field wiring, and digital coding necessary for the immediate and accurate re-broadcasting of the stored voice data into the appropriate amplifier input. Loss of operating power, supervisory power or any other malfunction which could render the digitalized voice module inoperative shall automatically cause the appropriate temporal tone to take over all functions assigned to the failed unit. Message shall utilize a male voice and shall be as follows:

“May I have your attention please. An emergency has been reported in the building. Please walk to the nearest fire stair or exit and exit the building.”

- I. Memory: Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors or other age-dependent devices shall not be considered as equal to non-volatile processors, PROMS or EMPROMS. The system history shall not require a printer to view.
- J. Field Programmability: Provide control units and control panels that are fully field programmable for control, initiating, supervisory, and trouble functions of both input and output. The system program configuration shall be menu driven. All system changes shall be password protected and shall be accomplished using personal computer based equipment.
- K. Circuits:
 - 1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
 - 2. Signaling Line Circuits: NFPA 72, Class B
 - 3. Notification Appliance Circuits: NFPA 72, Class B
 - 4. Serial Interfaces: R-232 ports for printers.
 - 5. Network Connection: NFPA 72, Class A
 - 6. Provide Pathway Survivability Level 1 for building that is fully sprinklered.
- L. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- M. Input/Output Modifications: The FACP shall contain features which allow the bypassing of input devices from the system or the modification of system outputs. These control features shall consist of a panel mounted keypad. Any bypass or modification to the system shall indicate a trouble condition at the FACP, VDU and a printed output of the trouble condition.
- N. Resetting: Provide the necessary controls to prevent the resetting of any alarm, supervisory or trouble signal while the alarm, supervisory or trouble condition on the system still exists.
- O. Instructions: Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory and trouble. The instructions shall be approved by the Owner's representative before being posted. Provide a second cabinet with O&M manuals, as-built drawings, and instructions mounted on the wall near the FACP, keyed as FACP.

- P. Walk Test: The FACP shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated on the system printer, but no other outputs occur.
- Q. Elevator Recall:
1. Smoke detectors at the following locations shall initiate automatic elevator recall
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
 3. Heat detectors in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
- R. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- S. Voice/Alarm Signaling Service:
1. Provide one channel for automatic transmission of announcements or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
 - a. Programmable tone and message sequence selection.
 - b. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - c. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones.
 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

2.11 AMPLIFIERS, PREAMPLIFIERS, TONE GENERATORS

- A. General: Any amplifiers, preamplifiers, tone generators, digitalized voice drives and all other hardware necessary for a complete, operational voice/alarm signaling service conforming to NFPA 72 shall be housed in a dedicated cabinet with 20-percent spare inner cabinet backbox space or in the main FACP. The system shall automatically transmit to all building fire alarm speakers. Each amplifier shall have, at a minimum, two channels: One to broadcast a message and the other for paging.
- B. Construction: All amplifiers shall utilize computer grade solid state components and shall be provided with output protection devices sufficient to protect the amplifier against any transient voltage surge up to ten times the highest rated voltage in the system.

- C. Inputs: Each system shall be equipped with separate inputs from the tone generator, digitalized voice driver and panel mounted microphone. Microphone inputs shall be of the low impedance, balanced line type. Both microphone and tone generator input shall be operational on any amplifier.
- D. Tone Generator: The tone generator shall be of the modular, plug-in type with securely attached labels to identify the component as a tone generator and to identify the specific tone it produces. The tone generator shall produce a distinct three-pulse temporal pattern in accordance with ANSI S3.41 and be constantly repeated until interrupted by either the digitalized voice message, the microphone input or the alarm silence mode as specified. The tone generator shall be single channel with an automatic back-up generator per channel such that failure of the primary tone generator causes the back-up generator to automatically take over the functions of the failed unit and also cause transfer of the common trouble relay.
- E. Protection Circuits: Each amplifier shall be constantly supervised for any condition which could render the amplifier inoperable at its maximum output. The audio riser shall be supervised for ground detection and low level circuit failure. Failure of any component or circuit shall cause automatic transfer to a designated back-up amplifier, illumination of a visual "amplifier trouble" indicator on the control panel, appropriate logging of the condition on the system printer and other actions for the trouble conditions as specified. The back-up amplifier(s) shall be provided at each bank of primary amplifiers. The back-up amplifiers shall be rated equivalent to the highest rated amplifier in the bank.

2.12 NOTIFICATION APPLIANCE (EXTENDER) PANELS

- A. General: Provide Simplex 6 amp extender panels for distributed strobe power supply. Provide emergency power and local battery backup. FACP shall monitor remote notification appliance panels for trouble conditions including low battery and notification appliance circuit fault. Voltage drop shall not exceed 15% on each circuit. Output shall not exceed 80% of rated capacity.

2.13 GRAPHIC (ANNUNCIATOR) PANEL

- A. Panel Graphics: Provide a graphic panel which indicates the building floor plan, including the location of all stairs and elevators. Stairs and elevators shall be identified by number. Alarm circuit boundaries shall be clearly marked on the floor plan. Graphics shall include a north arrow, location of the FACP, and a "You are Here" indicator.
- B. Indicating Lights: Provide the graphic panel with individual LED indicating lights for panel POWER ON indicator (graphic panel shall contain no zone or device LEDs). Refer to Sheet FA502 of the contract drawings for further information.
- C. Material: Provide a metallic faceplate with silkscreening. The LEDs shall be backlit. All control equipment and wiring shall be housed in a semi-flush mounted backbox. The exposed portion of the backbox shall be chrome plated with knockouts.
- D. Programming: Where programming for the operation of the proper LEDs is accomplished by a separate software program than the software for the fire alarm control panel, the software system shall not require reprogramming after loss of power. The software shall be reprogrammable in the field.

2.14 REMOTE NETWORK LCD ANNUNCIATOR / CONTROLLER

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Manufacturer and Model Requirement: Simplex model 4603-9101 Serial LCD Annunciator
 - 2. Mounted onto the graphic "annunciator" panel at the main fire department entrance.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.15 EMERGENCY POWER SUPPLY

- A. Batteries: Provide dry-type, sealed, maintenance free, lead-calcium batteries as the source for emergency power to the FACP. Batteries. The battery system shall be maintained in a fully charged condition by means of a solid state battery charger. Provide and automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power. Batteries shall have lead bolt-on or wing-nut-type terminals. Batteries with fast-tab terminals are unacceptable unless batteries are only manufactured with fast-tab terminals. These are small low voltage batteries.
- B. Capacity: Provide batteries with sufficient capacity to operate all signaling line circuits, initiating device circuits, and notification appliance circuits in normal or supervisory (non-alarm) mode for a period of 24-hours. Following this period of operation on battery power, the batteries shall have sufficient capacity to operate all components of the system in alarm mode for a period of 15-minutes at maximum connected load for voice alarm/communication.
- C. Battery Charger: Provide a solid state, fully automatic, variable charging rate battery charger. The charger shall be capable of providing 150-percent of the connected systems load and shall maintain the batteries at full charge. In the event the batteries are fully discharged the charger shall recharge them back to 95-percent of full charge within 48-hours. Provide pilot light to indicate when batteries are manually placed on a high rate of charger as part of the unit assembly if a high rate switch is provided. Provide a separate ammeter for recording rate of charge and a separate voltmeter to indicate the state of the battery charge or provide a system which displays this information as an integral part of the control panel.

2.16 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone lines and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall

initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
 - 1. Address of the alarm-initiating device.
 - 2. Address of the supervisory signal.
 - 3. Address of the trouble-initiating device.
 - 4. Loss of ac supply.
 - 5. Loss of power.
 - 6. Low battery.
 - 7. Abnormal test signal.
 - 8. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.17 SYSTEM PRINTER

- A. Manufacturer and Model Requirement: Simplex model 4190-9013 Fire alarm system remote printer
- B. Printer shall be listed and labeled by an NRTL as an integral part of fire-alarm system.

2.18 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by device manufacturer.
 - 2. Finish: Paint of color to match the protected device.

PART 3 EXECUTION

3.1 ELECTRIC POWER

- A. General: Provide primary power for the FACP from the normal AC service to the building where shown on the drawings. Power shall be 120-volt AC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of all circuits and devices. Make the service connection for the FACP at the emergency distribution panel where shown. Provide a separate NEMA 1 "General Purpose Enclosure" for the circuit breaker. The circuit breaker enclosure shall be painted red, marked FACP, and provided with a lockable handle or cover.
- B. Generator: Where any emergency generator provides a standby power supply for life safety system circuits, each fire alarm system panel shall be provided a dedicated circuit at each location shown on the plans.

3.2 SYSTEM FIELD WIRING

- A. Wiring within Cabinets, Enclosures, Boxes, Junction Boxes and Fittings: Provide wiring installed in a clean and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure or cabinet. All conductors which are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting or junction box shall be connected to terminal blocks and labeled. Mark each terminal in accordance with approved pressure type terminal blocks, which are securely mounted. The use of wire nuts or similar devices is prohibited.
- B. Terminal Cabinets: Provide a terminal cabinet at the base of any circuit riser, on each floor at each riser, and where indicated on the drawings. Terminal size shall be appropriate for the size of wiring to be connected. All conductor terminations shall be labeled and a drawing containing all conductors, their labels, their circuits and their interconnection shall be permanently mounted in the terminal cabinet. All terminal cabinets shall have 20-percent spare backbox space.
- C. Alarm Wiring: Signaling line circuits and initiating device circuit field wiring shall be solid copper, No. 18 AWG size conductors at a minimum. Visual alarm signal and audible appliance circuits shall be solid copper No. 14 AWG size conductors at a minimum. Speaker circuits shall be solid copper No. 16 AWG size conductors at a minimum. Wire size shall be sufficient enough to prevent voltage drop problems. Circuits operating at 24-volts DC shall not operate at less than 20.4-volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 15-percent of nominal voltage. Power wiring, operating at 120-volts AC minimum, shall be No. 12 AWG solid copper having similar insulation. Install all conductors in intermediate metallic conduit, electrical-metallic tubing with a minimum diameter of 3/4 -inch. The use of flexible conduit (MC) shall be permitted in concealed spaces. Run conduit or tubing concealed where recommended by the manufacturer. For shielded wiring, the shield shall be grounded at only one point, which shall be in or adjacent to the FACP. The drain or shield wires shall be treated as a fire alarm conductor, and shall be landed on terminal strips. The drain wire shall be sleeved or insulated to within 1-inch of its termination. T-taps are permitted in style 4 circuits with interconnections occurring on terminal strips. Circuits to fan shut down systems, door locking systems, and elevator control systems shall terminate in terminal cabinets within 3-feet of the

controllers for those systems. The completion of those circuits from the terminal cabinets to the appropriate system shall be provided under the appropriate division.

- D. Conductor Terminations: No specific color coding is required for any circuit; however, labeling of any circuit at terminal blocks in red colored terminal cabinets, FACP, and remote fire alarm control units shall be provided at each conductor connection. Each conductor or cable shall have a permanent label to provide a unique and specific designation. Each terminal cabinet, FACP and remote fire alarm control unit shall contain a laminated drawing which indicates each conductor, its label, circuit and terminal. The laminated drawing shall be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel or unit so that it does not interfere with the wiring or terminals.

3.3 FIRE STOPPING

- A. General: Firestop all holes for conduit, piping, or other penetrations which pass through floor slabs, fire-rated walls, partitions with fire-rated doors, vertical service shafts, or any fire-rated assembly. Refer to Division 07 Section "Interior Joint Sealants" for materials and installation.

3.4 SMOKE PENETRATION SEALING

- A. Fill the void opening around the item penetrating the wall with a noncombustible material such as mineral wool or another listed fill-void material. The fill void material shall have a coating of sealant applied and smoothed to close any gaps. The sealant shall be non-combustible or have a Class A flame spread combustibility rating.

3.5 INSTALLATION OF FIRE ALARM INITIATING AND INDICATING DEVICES

- A. FACP: Locate the FACP where indicated on the drawings. Surface mount the enclosure with the top of the cabinet 6-feet above the finished floor or center the cabinet at 6-feet, whichever is lower. All conductor terminals shall be labeled and a drawing containing all conductors, their labels, their circuits and their interconnection shall be permanently mounted in the FACP.
- B. Manual Pull Stations: Locate manual pull stations where shown on the drawings. Mount stations so that their operating handles are 42-inches above the finished floor at base of operable portion.
- C. Notification Appliance Devices: Locate notification appliance devices where shown on the drawings. Mount assemblies on walls between 80-inches and 96-inches above the finished floor or 6-inches below the ceiling, whichever is lower.
- D. Smoke and Heat Detectors: Locate detectors as shown on the drawings on a 4-inch mounting box. Detectors located on the ceiling shall be installed not less than 4-inches from a side wall to the near edge. Those located on the wall shall have the top of the detector at least 4-inches below the ceiling, but not more than 12-inches below the ceiling. In the case of solid joist construction, the detectors shall be mounted on the bottom of the joists. On smooth ceilings, detectors shall be installed not over 30-feet apart in any direction. Closer spacing shall be used when recommended by the detector manufacturer or required by NFPA 72. Install smoke detectors no closer than 5-feet from air handling supply outlets. Heat detectors shall be installed

in strict accordance with their UL listing. Where heat detectors are mounted at the underside of beams, the allowable spacing for the heat detectors shall be 70-percent of the listed spacing.

- E. Graphic Panel and LCD Annunciator / Controller: Locate in the location shown on the drawings.
- F. Water Flow Detectors and Tamper Switches: Make connections to waterflow detectors and tamper switches provided under division 21 Section "Water-Based Fire Suppression Systems". Approximate locations are indicated on the drawings. Coordinate exact locations with the fire sprinkler system contractor.

3.6 TESTS

- A. Megger Tests: After all wiring has been installed, and prior to installing any devices, all wiring shall be megger tested for installation resistance, grounds, and/or shorts. Conductors with 300-volt rated insulation shall be tested at a minimum of 250-volts DC. Conductors with 600-volt rated insulation shall be tested at a minimum of 500-volts DC. The tests shall be witnessed by the Owner's representative and test results recorded for use at the final acceptance test.
- B. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Owner's representative and test results recorded for use at the final acceptance test.
- C. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. Tests shall meet the requirements of paragraph 3.6 of this section. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The letter shall include the names and titles of witnesses to the preliminary tests. The contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- D. Final Testing: Notify the Owner's representative in writing when the system is ready for final acceptance testing. The system must be online and have no troubles for 1-week prior to scheduling the final test. Submit request for test at least 15 calendar days prior to the test date. A final acceptance test will not be scheduled until the following are provided at the job site:
 - 1. Marked-up red line drawings of the system actually installed.
 - 2. A disk copy of the fire alarm program, as installed.
 - 3. Megger test results.
 - 4. Loop resistance test results.
 - 5. Complete program printout including all input/output addresses.
 - 6. The final test shall be witnessed by the Owner's representative. At this time, any and all required tests shall be repeated at the discretion of the Owner. The panel shall be free of all troubles and alarms at the final acceptance. If there are any troubles or alarms the test will be terminated. Following acceptance of the system, as-built drawings and Operation and Maintenance (O&M) Manuals shall be delivered to the Owner's representative for review and acceptance.

3.7 MINIMUM SYSTEM TESTS

- A. General: Test the system in accordance with the procedures outlined in NFPA 72 and the City of Rockville requirements, including all pre and final testing per the Rockville FPEDE. The required tests are as follows:
1. Verify the absence of unwanted voltage between circuit conductors and ground. The tests shall be accomplished at the preliminary test with the results available at the final system test.
 2. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
 3. Test each initiating and indicating device and circuit for proper operation and response at the control unit.
 4. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
 5. Test both primary and secondary power. Verify, by test, the secondary power system is capable of operating the system for the time period in the manner specified.
 6. Determine that the system is operable under trouble conditions as specified.
 7. Visually inspect all wiring.
 8. Test the battery charge and batteries.
 9. Verify that all software control and data files have been entered or programmed into the FACP. Hard copy records and electric file copies of the software shall be provided to the Owner's representative.
 10. Verify that red-line drawings are accurate.
 11. Measure the current in circuits to assure there is the calculated space capacity for the circuits.
 12. Measure voltage readings for circuits to assure that voltage drop is not excessive.
 13. Measure the voltage drop at the most remote appliance on each notification appliance circuit.

3.8 SPARE PARTS AND TOOLS

- A. Interchangeable Parts: All spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts shall be delivered to the Owner.
- B. Parts List: Furnish a list, in duplicate, of all other parts and accessories which the manufacturer of the system recommends to be stocked for maintenance.

3.9 KEYS

- A. General: Keys and locks for all equipment shall be identical. Provide not less than six keys for each type required. All keys shall be CAT 104.

END OF SECTION 283111

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. City of Rockville approved Sediment Control Plan and Permit.

1.2 SUMMARY

A. Section Includes:

- 1. Protecting existing vegetation to remain.
- 2. Removing existing vegetation.
- 3. Clearing and grubbing.
- 4. Stripping and stockpiling topsoil.
- 5. Removing above- and below-grade site improvements.
- 6. Disconnecting, capping or sealing, and removing site utilities.
- 7. Temporary erosion- and sedimentation-control measures.

B. Related Sections:

- 1. Division 01 Section "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.
- 2. Division 01 Section "Execution" for field engineering and surveying.
- 3. Division 01 Section(s) "Construction Waste Management and Disposal and "Sustainable Design Requirements" for additional LEED requirements.
- 4. Division 02 Section "Structure Demolition" for demolition of buildings, structures, and site improvements.
- 5. Division 02 Section "Selective Structure Demolition" for partial demolition of buildings or structures.

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.
- D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.
- G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or videotape.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify utility locator service and Miss Utility for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- E. The following practices are prohibited within protection zones:
 1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
- H. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving."
 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.

- B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag each tree trunk at 54 inches above the ground.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. General: Protect trees and plants remaining on-site according to requirements in Division 01 Section "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.
 - 2. Owner will arrange to shut off indicated utilities when requested by Contractor.
- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than three days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.
- D. Removal of underground utilities is included in Division 22 Sections.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods for grubbing within protection zones.
 - 4. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within protection zones.
 - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
 - 4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for walks, turf and grasses and plants.
2. Subbase course for concrete walks.
3. Subsurface drainage backfill for walls and trenches.
4. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Sections:

1. Division 01 Section "Construction Progress Documentation and Photographic Documentation" for recording preexcavation and earth moving progress.
2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
3. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
4. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
5. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
6. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction.
7. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
8. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
9. Division 32 Section "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.
10. Division 33 Section "Subdrainage" for drainage of walls and landscaped areas.

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices for earth moving specified in Division 01 Section "Unit Prices."

- B. Quantity allowances for earth moving are included in Division 01 Section "Allowances."
- C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.
 - 1. 24 inches outside of concrete forms other than at footings.
 - 2. 12 inches outside of concrete forms at footings.
 - 3. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - 4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - 5. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices and changes in the Work.
 - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- F. Fill: Soil materials used to raise existing grades.
- G. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles.
 - 2. Controlled low-strength material, including design mixture.
 - 3. Warning tapes.
- B. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Geotextile: 12 by 12 inches.
 - 2. Warning Tape: 12 inches long; of each color.
- C. Qualification Data: For qualified testing agency.
- D. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698
- E. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- B. Preexcavation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining walks and other adjacent occupied or used facilities during earth moving operations.
 - 1. Do not close or obstruct walks or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service Miss Utility for area where Project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 31 Section "Site Clearing," are in place.
- D. Do not commence earth moving operations until plant-protection measures specified in Division 01 Section "Temporary Tree and Plant Protection" are in place.
- E. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487 free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C 33; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 1. Survivability: Class 2; AASHTO M 288.
 2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
 3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
 4. Tear Strength: 56 lbf; ASTM D 4533.
 5. Puncture Strength: 56 lbf; ASTM D 4833.
 6. Apparent Opening Size: No. 40, No. 60, No. 70 sieve, maximum; ASTM D 4751.
 7. Permittivity: 0.5 per second, minimum; ASTM D 4491.
 8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.

8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Produce low-density, controlled low-strength material with the following physical properties:

1. As-Cast Unit Weight: 36 to 42 lb/cu. ft. at point of placement, when tested according to ASTM C 138/C 138M.
2. Compressive Strength: 140 psi when tested according to ASTM C 495.

2.4 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches (beneath bottom of concrete slabs-on-grade).
 - f. 6 inches beneath pipe in trenches, and the greater of 24 wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

- D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

- A. Notify Architect when excavation have required subgrade.
- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete Miscellaneous Cast-in-Place Concrete."
- D. Backfill voids with satisfactory soil while removing shoring and bracing.
- E. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.
- G. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- H. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- I. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch.
 - 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches (150 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
 - 2. Place and compact impervious fill over drainage backfill in 6-inch thick compacted layers to final subgrade.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase course and base course to required crown elevations and cross-slope grades.
4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 2. Determine that fill material and maximum lift thickness comply with requirements.
 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
1. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Soil treatment with termiticide.

- B. Related Sections:

- 1. Division 07 Section "Sheet Metal Flashing and Trim" for custom-fabricated, metal termite shields.

1.3 SUBMITTALS

- A. Product Data: For each type of termite control product.

- 1. Include the EPA-Registered Label for termiticide products.

- B. Qualification Data: For qualified Installer.

- C. Product Certificates: For termite control products, from manufacturer.

- D. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

- 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Termiticide brand name and manufacturer.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes used, and rates of application.
 - 6. Areas of application.
 - 7. Water source for application.

- E. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. **Installer Qualifications:** A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who employs workers trained and approved by manufacturer to install manufacturer's products, and who is accredited by manufacturer.
- B. **Regulatory Requirements:** Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.
- C. **Source Limitations:** Obtain termite control products from single source from single manufacturer.
- D. **Preinstallation Conference:** Conduct conference at Project site

1.5 PROJECT CONDITIONS

- A. **Environmental Limitations:** To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

1.6 WARRANTY

- A. **Soil Treatment Special Warranty:** Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

- 1. **Warranty Period:** Five years from date of Substantial Completion.

1.7 MAINTENANCE SERVICE

- A. **Continuing Service:** Beginning at Substantial Completion, provide 12 months' continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, terms for agreement period, and terms for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

- A. **Termiticide:** Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum

termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Corporation, Agricultural Products; Termidor.
 - b. Bayer Environmental Science; Premise 75.
 - c. FMC Corporation, Agricultural Products Group; Talstar
 - d. Syngenta; Demon TC.
2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
 1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 3. Crawlspace: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
 4. Masonry: Treat voids.
 5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- D. Post warning signs in areas of application.
- E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 313116

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Walks.

- B. Related Sections:

- 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Division 32 Section "Decorative Concrete Paving" for stamped concrete other than detectable warnings.
 - 3. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. LEED Submittals:

- 1. Product Data for Credit MR 4.1. For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
 - 2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements. For each design mixture submitted, include an equivalent concrete mixture that does not contain portland cement replacements, to determine amount of portland cement replaced.

- C. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- D. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.
- E. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:
 - 1. Exposed Aggregate: 10-lb Sample of each mix.
- F. Other Action Submittals:
 - 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- G. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.
- H. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
- I. Material Test Reports: For each of the following:
 - 1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- J. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
- E. ACI Publications: Comply with ACI 301 unless otherwise indicated.
- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
 - 2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 by 96 inches. Retain first subparagraph below if mockups are not only for establishing appearance factors.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized-steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.
- E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- F. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
- G. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- H. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
- I. Plain-Steel Wire: ASTM A 82/A 82M, galvanized.
- J. Deformed-Steel Wire: ASTM A 496/A 496M.
- K. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, deformed.
- L. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 -steel bars zinc coated after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.
- M. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain-steel bars.
- N. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- O. Hook Bolts: ASTM A 307, Grade A , internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- P. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

R. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, white portland cement Type II.
2. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag cement.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Axim Italcementi Group, Inc.; Caltexol CIMFILM.
 - b. BASF Construction Chemicals, LLC; Confilm.
 - c. ChemMasters; Spray-Film.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; VaporAid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation, Inc.; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
 - b. ChemMasters; Safe-Cure Clear.
 - c. Conspec by Dayton Superior; D.O.T. Resin Cure.
 - d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - e. Edoco by Dayton Superior; Resin Emulsion Cure V.O.C. (Type I).
 - f. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
 - g. Kaufman Products, Inc.; Thinfilm 420.
 - h. Lambert Corporation; AQUA KURE - CLEAR.
 - i. L&M Construction Chemicals, Inc.; L&M CURE R.
 - j. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
 - k. Nox-Crete Products Group; Resin Cure E.
 - l. SpecChem, LLC; PaveCure Rez.
 - m. Symons by Dayton Superior; Resi-Chem Clear.
 - n. Tamms Industries, Inc., Euclid Chemical Company (The); TAMMSCURE WB 30C.
 - o. TK Products, Division of Sierra Corporation; TK-2519 WB or TK-2519 DC WB.
 - p. Vexcon Chemicals Inc.; Certi-Vex EnvioCure 100.

2.5 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ChemMasters; Exposee.
 - b. Conspec by Dayton Superior; Delay S.
 - c. Dayton Superior Corporation; Sure Etch (J-73).
 - d. Edoco by Dayton Superior; True Etch Surface Retarder.
 - e. Euclid Chemical Company (The), an RPM company; Surface Retarder Formula S.
 - f. Kaufman Products, Inc.; Expose.
 - g. Meadows, W. R., Inc.; TOP-STOP.
 - h. Metalcrete Industries; Surfard.
 - i. Nox-Crete Products Group; CRETE-NOX TA.
 - j. Scofield, L. M. Company; LITHOTEX Top Surface Retarder.
 - k. Sika Corporation, Inc.; Rugasol-S.
 - l. SpecChem, LLC; Spec Etch.
 - m. TK Products, Division of Sierra Corporation; TK-6000 Concrete Surface Retarder.
 - n. Unitex; TOP-ETCH Surface Retarder.
 - o. Vexcon Chemicals Inc.; Certi-Vex Envioset.

2.6 DETECTABLE WARNING MATERIALS

- A. Detectable Warning Stamp: Semirigid polyurethane mats with formed underside capable of imprinting detectable warning pattern on plastic concrete; perforated with a vent hole at each dome.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Surfaces Inc.
 - b. Matcrete Precision Stamped Concrete Tools.
 - c. Southern Color N.A., Inc.
 - d. Stampcrete International Ltd.
 - e. Superior Decorative by Dayton Superior.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- C. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use high-range, water-reducing admixture in concrete as required for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- D. Cementitious Materials: Limit percentage by weight of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals. as follows:
 1. Fly Ash or Pozzolan: 25 percent.
 2. Ground Granulated Blast-Furnace Slag: 50 percent.
 3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement and items to be embedded or cast-in.

- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 DETECTABLE WARNINGS

- A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Division 32 Section "Unit Paving".
 1. Tolerance for Opening Size: Plus 1/4 inch no minus.
- B. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.
 1. Before using stamp mats, verify that the vent holes are unobstructed.
 2. Apply liquid release agent to the concrete surface and the stamp mat.
 3. Stamping: While initially finished concrete is plastic, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
 4. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.
 5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint

patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

3.9 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture-retaining-cover curing, curing compound or a combination of these as follows:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 3/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/2 inch.
 - 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 - 5. Lateral Alignment and Spacing of Dowels: 1 inch.
 - 6. Vertical Alignment of Dowels: 1/4 inch.

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each 5000 sq. ft. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.12 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321400 – UNIT PAVERS

PART I - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Work includes:
 - 1. Concrete pavers
 - 2. Aggregate sub-base
 - 3. Concrete base course
 - 4. Bituminous setting bed
 - 5. Polymeric sand Joint filler

1.3 RELATED WORK

- A. Cast-in-Place Concrete: Base course.

1.4 SUBMITTALS

- A. Mix ratio from batch plant verifying material and properties in paragraph 2.5.
- B. Product samples for the following:
 - 1. Concrete pavers for each color.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed unit paver installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Single-Source Responsibility: Obtain each color, type, and variety of unit pavers, joint materials, and setting materials from a single source with resources to provide products and materials of consistent quality in appearance and physical properties without delaying the Work.
- C. Mockup: Prior to installing unit pavers, construct mockups for each form and pattern of unit pavers required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution.

1. Locate mockup on-site in the location and of the size indicated complete, min. 5' x 5' showing the color range of the product and cutting of corner pieces.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect unit pavers and aggregate during storage and construction against contamination from earth and other materials.

1.7 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Install bituminous setting bed when the temperature is between 40 and 100 degrees and dry.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Concrete Pavers:
 - a. Hanover Architectural Products, Inc.

2.2 COLORS AND TEXTURES

- A. Provide materials and products that result in colors and textures of exposed unit paver surfaces and joints complying with the following requirements and with existing installation:
 1. Match color and texture indicated by referencing manufacturer's standard designations for these characteristics.
- B. Schedule:

Size	Type	Finish	Color
4" x 8" x 2-3/8"	Prest Brick	Natural	Salmon/Charcoal Blend (field)
4" x 8" x 2-3/8"	Prest Brick	Natural	Chocolate (header course)
24" x 24" x 2"	Prest Paver	Tudor	M1363 (field pavers)
12" x 24" x 2"	Prest Paver	Finish 13	M1428 (border pavers)

C. UNIT PAVERS

1. Concrete Pavers: Hanover Prest brick, and Hanover prest pavers. Solid, interlocking paving units, ASTM C 936, made from normal-weight aggregates in sizes and shapes indicated.

2.3 AGGREGATE SUB-BASE

A. CR-6 or equal material-see engineer's plan.

2.4 CONCRETE BASE COURSE

A. See site paving details for slab thickness. Strength of the concrete shall be 4000 psi.

2.5 BITUMINOUS SETTING BED MATERIALS

A. Bituminous setting bed mix ratio

1. Mix bituminous setting-bed materials at an asphalt plant in approximate proportion, by weight, of 7 percent asphalt cement to 93 percent fine aggregate, unless otherwise indicated. Heat mixture to 300 deg F.

B. Primer for Base: ASTM D 2028, cutback asphalt, grade as recommended by unit paver manufacturer.

C. Fine Aggregate for Setting Bed: ASTM D 1073, No. 2 or No. 3.

D. Asphalt Cement: ASTM D 3381, Viscosity Grade AC-10 or Grade AC-20.

E. Neoprene-Modified Asphalt Adhesive: Paving manufacturer's standard adhesive consisting of oxidized asphalt combined with 2 percent neoprene and 10 percent long-fibered mineral fibers containing no asbestos.

2.6 SAND JOINT FILLER

A. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of unit pavers. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Vacuum clean concrete substrates to remove dirt, dust, debris, and loose particles.
- B. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
- C. Proof-roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction. Do not proceed with installation of unit pavers until deficient subgrades have been corrected and are ready to receive subbase for unit pavers.

3.3 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, and other effects that might be visible or cause staining in finished work.
- B. Mix pavers from several pallets or cubes as they are placed to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
- D. Minimum size of cut paver shall be 16 sq. inches with no dimension less than 1" back cut pavers where needed to maintain minimum size.
- E. Joint Pattern: Match field-constructed mockup.
- F. Tolerances: Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.
- G. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide cork joint filler as backing for foam backer rod. Install cork joint filler before setting pavers.
- H. Install job-built concrete edge restraints to comply with requirements of Cast-in-Place Concrete.

3.4 AGGREGATE SUB-BASE

- A. Install aggregate to the depth indicated on the drawings.

3.5 CONCRETE BASE COURSE

- A. Install concrete base with reinforcing as indicated on the engineer's details.

3.6 ASPHALT SETTING-BED PAVER APPLICATIONS

- A. Apply primer to concrete slab or binder course immediately before placing setting bed.
- B. Prepare for setting-bed placement by locating 3/4-inch deep control bars approximately 11 feet apart, to serve as guides for striking board. Adjust bars for accurate setting of paving units to finished grades indicated.
- C. Place bituminous setting bed between control bars. Spread mix at a minimum temperature of 250 deg F . Strike setting bed smooth, firm, even, and not less than 3/4 inch thick. Add fresh bituminous material to low, porous spots after each pass of striking board. Carefully fill depressions that remain after removing depth-control bars.
- D. Roll setting bed with power roller to a nominal depth of 3/4 inch. Adjust thickness as necessary to allow accurate setting of unit pavers to finished grades indicated. rolling before mix temperature cools to 185 deg F.
- E. Apply neoprene-modified asphalt adhesive to cold setting bed by squeegeeing or troweling to a uniform thickness of 1/16 inch. Proceed with setting of paving units only after adhesive is tacky and surface is dry to touch.
- F. Place pavers carefully by hand, maintaining accurate alignment and uniform top surface. Protect newly laid pavers with plywood panels on which workers can stand. If additional leveling of paving is required, and before treating joints, roll paving with power roller.

3.7 JOINT TREATMENT

- A. Place unit pavers with hand-tight joints. Fill joints by sweeping sand over paved surface until joints are filled. Remove excess sand after joints are filled.

3.8 REPAIR, JOINTING, CLEANING, AND PROTECTION

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment to eliminate evidence of replacement.

- B. Cleaning: Remove excess joint filler from exposed paver surfaces; wash and scrub clean.
 - 1. Cover areas with plywood subject to construction vehicular traffic.

- C. Provide protection that ensures that unit paver work is without damage or deterioration at the time of Substantial Completion

END OF SECTION 321400

SECTION 329200 – SEEDING & SODDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Work Includes:
 - 1. Finish grading.
 - 2. Sodding.

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people.
- D. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments.
- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. No samples necessary.
- B. Certification of sod seed mix.
- C. Soil test of existing soil with recommendations for amendments.

1.5 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
- B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.
 - 1. The contractor shall oversee soil sampling.
 - 2. Report suitability of tested soil for turf growth.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original unopened containers.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: State-certified seed of grass species as follows:
 - 1. Full Sun: Proportioned by weight as follows:

- 80% Turf type Tall Fescue (½ Rebel II, ½ On Cue) or similar
 - 10% Perennial Ryegrass (Palmer III or Jet)
 - 10% Kentucky Bluegrass (Georgetown or Nassau)

- 2. Supplier: Pennington Seeding

2.2 TURFGRASS SOD

- A. Turfgrass Species: Sod of grass species shall match seed mix as closely as possible. Submit mix for approval.

2.3 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
- B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.4 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of 5 to 10 decisiemens not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

2.5 FERTILIZERS

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorus, and potassium in the following composition:
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

2.6 PLANTING SOILS

- A. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 2 percent organic material content existing, in-place surface soil or imported topsoil or manufactured topsoil from off-site sources. Verify suitability of soil to produce viable planting soil.

2.7 WOOD CELLULOSE MULCH

- A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.8 PESTICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 TURF AREA PREPARATION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer directly to subgrade before loosening.
 - 2. Spread topsoil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if topsoil or subgrade is frozen, muddy, or excessively wet.
 - a. Reduce elevation of planting soil to allow for soil thickness of sod.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

- D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
1. Lay sod across angle of slopes exceeding 1:3.
 2. Anchor sod on slopes exceeding 1:6 or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.3 TURF MAINTENANCE

- A. Maintain and establish turf until acceptance by Owner. Maintenance shall include watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
- B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain height appropriate for species without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings.
- C. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

3.4 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft and bare spots not exceeding 5 by 5 inches.
 - 2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

END OF SECTION 329200

SECTION 329300 – TREES, SHRUBS AND GROUND COVERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Work Includes

1. Where necessary to facilitate new construction, remove existing trees, shrubs, and ground covers with the architect's permission, the completion of construction, replace removed trees, shrubs, and ground cover with same species and size to match existing.
2. Tree pit preparation and topsoil backfill.
3. Trees, plants and ground cover plant material.
4. Maintenance.
5. In the event of a discrepancy between the plant list and the plans, the plans shall govern.

1.3 RELATED SECTIONS

- A. Section 329200 - Seeding and Sodding: Placing of topsoil.

1.4 DEFINITIONS

- A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.
- B. Soil test: provide test results of on-site soil and borrow with recommendations for all additives.
- C. Backfill Soil Mix: 1/3 existing soil from excavation, 1/3 imported topsoil, 1/3 organic material.
- D. Bio-retention soil mix: See civil engineer's drawings.

1.5 SUBMITTALS

- A. Test Results: Topsoil – both existing and borrow stockpiles.
- B. Product Data: Fertilizer, lime, peat moss, herbicides, pesticides, mulch and landscape edging.
- C. Samples: none required
- D. Source of supply of plants. Trees will be field selected from a grower within the local area.

1.6 QUALITY ASSURANCE

- A. Provide for nursery inspection by the Landscape Architect to verify acceptability of plants. Inspection at the source does not preclude rejection at the site due to size, shape, handling damage, or the presence of insects and diseases.
- B. All plants shall conform to the reference standard and plants must be selected from nurseries that have been inspected and certified by state plant inspectors.
- C. Unless otherwise noted, all plants shall be nursery grown in accordance with good horticultural practices, and shall be grown under climatic conditions and soil type similar to those of the site for at least two years. They shall be healthy, vigorous plants free from defects, decay, disfiguring roots, sun-scald injuries, abrasions of the bark, plant diseases, insect pests eggs, borers and all forms of infestations or objectionable disfigurements. All old abrasions and cuts shall be completely calloused over.
- D. Plants will be subject to inspection at the source of supply for quality, shape, size and color. Plant shapes shall be consistent with the plants natural growth habit and nursery standards for good quality plant material. Trees shall have straight trunks with the main leader intact, undamaged and uncut. Branching shall be uniform, full and consistent with the plants natural growth habit. Plants lacking compactness or proper proportions, trees with structurally weak branching forms that may lead to future breakage, or plants misshapen by too close planting in nursery rows will not be accepted.
- E. All trees and shrubs shall be measured when their branches are in their normal position. Height and spread dimensions specified refer to the main body of the plant. The determining measurement for trees shall be caliper, which shall

conform to ANSI Z60.1, most current edition. All plants shall conform to the measurements specified in the Plant Lists.

- F. If a range of size is given, no plant shall be less than the minimum size and not less than 50 percent of the plants shall be as large as the maximum size specified. The measurements specified are the minimum size acceptable and are the measurements after pruning where pruning is required.
- G. Evergreens shall be dense, compact and uniform in shape; trees shall not be unnaturally sheared and main leaders must be intact and healthy.
- H. Collected material may be used only when approved by the Landscape Architect.
- I. Container grown stock shall not be pot bound and shall have been grown in a container large enough for the root system to develop sufficiently to hold its soil together when removed. Plants shall be grown in the container [of the size designated in the plant list] for at least 6 months. Ground covers grown in peat pots shall have roots throughout the container or protruding through the sides of the peat pot.

1.7 REGULATORY REQUIREMENTS

- A. Comply with regulatory requirements for fertilizer, herbicide and pesticide composition and application.
- B. Provide certificate of compliance from State Department of Agriculture indicating approval of fertilizer, herbicide mixture and certification that plant material is free of diseases or insects.
- C. Comply with regulatory inspection by Federal or State agencies for procurement of collected plant material.

1.8 STANDARDS / REFERENCES

- A. Nomenclature: In accordance with Hortus III by D. H. Bailey.
- B. American Standards for Nursery Stock (ANSI Z60.1 – most current edition). American Association of Nurserymen, Washington, D.C.
- C. Tree: Provide trees grown in a state inspected and certified nursery in accordance with good horticultural practice. Plant material shall conform to the most current edition of the American Standard for Nursery Stock published by the American Association of Nurserymen and be healthy, vigorous, free of disease, insects, eggs, larvae, and defects such as knots, sun-

scald, injuries, abrasions or disfigurement. Trees shall be matched as noted on the bid sheet.

- D. MSMT603-Maryland Standard Method of Testing (SHA).

1.9 SEQUENCING AND SCHEDULING OF WORK

- A. Coordinate work with General Contractor.
- B. Coordinate the work of this Section with installation of underground irrigation system, utilities, piping and electrical lines.

1.10 PLANTING SEASON

- A. Planting shall be conducted during the period of March 15th through June 15th or September 15th through December 15th.
- B. Variations to the schedule shall require consent from the Owner's representative or Architect. Requests shall be submitted in writing.

1.11 WARRANTY

- A. Provide a warranty on work of this Section for a minimum one-year including one continuous growing season. Commence warranty on date identified in the Certificate of Substantial Completion.
- B. Warranty: Include coverage for loss of plants from death due to unhealthy conditions or lack of contractor maintenance.
- C. Replacements: Plants of same size and species as specified, planted in the next growing season.
- D. Inspection or Initial Acceptance:
 - 1. Warranty shall begin after landscape inspection and acceptance.
 - 2. Inspection shall be made by the Owner or Owner's representative and the Contractor within two weeks of written notification from the Contractor.
 - 3. During the year warranty, settled plants shall be reset to proper grade and position, dead material removed, within a reasonable time and documented in writing.
 - 4. The Contractor will conduct a final inspection with the Owner or Owner's representative at the end of the one-year period. It will be

the Contractor's responsibility to notify the Owner within 10 days of the anticipated meeting.

5. Any material that is 25 percent dead or more shall be considered dead and must be replaced at no charge, providing that the Contractor has received or if in the opinion of the Owner's representative the tree is disfigured and or has lost its landscape value.
6. Contractor shall remove and dispose of all staking and guying materials prior to the one-year warranty.

1.12 SUBSTITUTIONS

- A. If a plant is found not to be suitable or available, the Contractor shall notify the Architect before bidding.
- B. The Owner or Architect will consider reasonable alternatives.
- C. Following bidding, if a substitute is required, it must be of the same size, and quality as the original specified plant.

1.13 REPLACEMENTS AND CONDITIONS

- A. Replacements will be made during the next planting period unless the Contractor agrees to an earlier date.
- B. There will be a one-time full replacement policy.
- C. A replacement will be of the same size as the original with no additional soil additives to be used.
- D. The Contractor will not be responsible for plant material that has been damaged by vandalism, fire, removal, relocation or other activities beyond the Contractor's control.
- E. Plant losses due to abnormal weather conditions such as floods, excessive wind damage, drought, severe freezing or abnormal rains will in no way be the responsibility of the Contractor.
- F. Groundcovers, broadleaf evergreens, red, willow and scarlet oaks and all conifers except white pines will not be planted between November 15 and March 15. An exception would be considered if the Contractor states in writing that he will guarantee plant material at this time.

- G. Any existing trees, shrubs, and groundcovers damaged due to new construction shall be replaced with same species and size to match existing.

1.14 MAINTENANCE MANUAL

- A. Maintenance Data: Include cutting and trimming method; types, application frequency, and recommended coverage of fertilizer. Include procedures for Integrated Pest Management (IPM) program.
- B. Submit 2 copies to Owner at time of initial acceptance.

1.15 MAINTENANCE SERVICE

- A. Maintenance Services: Performed by installer until the end of the warranty period.
- B. Maintain plant life immediately after placement.
- C. Maintenance to include:
 - 1. Weeding plant beds and tree pits, minimum of sixteen (16) weedings.
 - 2. Applying herbicides for weed control in accordance with manufacturer's instructions.
 - 3. Apply pesticides only as needed.
 - 4. Water at a sufficient frequency to saturate root system and keep soil moist. Pruning, including removal of dead or broken branches, and treatment of pruned areas or other wounds.
 - 5. Provide disease control only as needed.
 - 6. Maintaining wrapping, guys, turnbuckles, stakes and mulch. Repair or replace accessories when required.
 - 7. Straighten trees and adjust root ball as needed.
 - 8. Remove all wrapping and stakes at the end of the guarantee period.
 - 9. Rake out the edge of all mulch rings at the base of all trees at the end of the guarantee period.
- D. Planting areas and plants shall be protected at all times against damage of any kind for the duration of the maintenance and guarantee period. If any plants become damaged or injured, they shall be treated or replaced as directed by the Landscape Architect at no additional cost to the Owner. The Contractor shall not be responsible for acts of vandalism during the maintenance and guarantee period.

- E. Refertilization shall be at the rate of one pound of fertilizer to 30 gallons of water per tree 3 inch caliper and larger, all smaller trees at the rate of one-third pound of fertilizer to 10 gallons of water per tree; applied every three weeks between May 15 and July 1. Shrubs shall be re-fertilized with this same mixture at the rate of one gallon per shrub and vines at the rate of one pint per vine, applied every three weeks between May 15 and July 1. Fertilizer shall be an approved brand; completely water soluble at a rate dictated by soil test results.
- F. Apply pesticides in accordance with manufacturers' instructions. Remedy damage resulting from improper use of pesticides.
- G. All planting and plant materials shall be in satisfactory and acceptable condition during and at the end of the maintenance and guarantee period. Trees with abrasions of the bark, sunscalds, disfiguring knots, or fresh cuts of limbs over 1 1/4 inches which have not completely calloused over will be rejected.
- H. Maintenance Reports: Landscape Contractor shall provide Landscape Maintenance Reports with each site visit, including date of work, name of site foreman, tasks completed, number of hours spent, materials or chemicals applied and areas in which work was completed.
- I. The Contractor shall prepare within 10 days of the initial acceptance or inspection, a maintenance manual for use by the Owner after the guarantee period expires.

PART 2 PRODUCTS

2.1 PLANT MATERIALS

- A. Provide freshly dug trees, shrubs, and other plants complying with recommendations and requirements of ANSI Z60.1 (most current edition) "Standard for Nursery Stock" and as specified on the plans and drawings.
- B. Submit source of supply for approval.

2.2 TOPSOIL FOR BACKFILL

- A. Existing or imported soil reasonably free of stones, lumps, plants, roots and other debris over an inch in diameter which conforms to the following criteria:

pH range	5.0 - 7.0
Organic matter	1.0 - 1.5%
Magnesium - Mg	100 + units

Phosphorus - P205 150 + units
Potassium - K20 120 + units
Soluble salts/Conductivity -
not to exceed 900 ppm//0.9 mmhos/cm (in soil)
not to exceed 3000 ppm/2.5 mmhos/cm (in high organic mix)

- B. Submit soil test results before placing any material on site. Provide list of additives.
- C. Soil shall also be free of plants or plant parts of Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

2.3 COMMERCIAL FERTILIZER

- A. Fertilizer: FS O-F-241, Type 1, Grade A: Granular packet, or pellet form with 35-80% of the total nitrogen in a slow release form with fifty percent of the elements derived from organic sources. Sulfur coated and IBDU fertilizers are not permitted.
- B. For trees, shrubs, and groundcovers, provide a complete fertilizer with a minimum analysis of 10%N - 6%P - 4%K.

2.4 MULCH

- A. Material shall be either composted hardwood bark, or approved equal and shall be mulching grade, uniform size and free of foreign matter. Wood chips will not be accepted.
- B. Submit sample with bid.

2.5 ORGANIC MATTER

- A. Peatmoss – Type 1, Shredded, loose, finely divided, sphagnum peat moss; free of lumps, roots, inorganic or acidic materials; minimum of 85 percent organic material measured by oven dry weight, pH range of 4.5 to 6.5; moisture content of 30 percent.
- B. Leaf Mold – Thoroughly shredded, well-composted leaf material, free of trash such as 'Leafgro' or approved equal.
- C. Composted Sewage Sludge – Approved, screened, polymer-dewatered sewage sludge with a pH of 6.0 – 7.0.
- D. Contractor shall submit the type of organic material proposed for the project.

2.6 AMENDMENTS

- A. Lime: ground limestone, dolomite type, minimum 95 percent carbonates. At least 50% total oxides content, ground or pulverized (at least 50% will pass through a 100-mesh sieve and 98-100% will pass through a 20-mesh sieve).
- B. Sulfur: Iron sulfate or elemental sulfur powder (95% sulfur).

2.7 ACCESSORIES

- A. Anti-desiccant: "Wiltproof" by Nursery Specialty Products, Inc., Groton Falls, NY or approved equal.
- B. Stakes: 2 inch by 2 inch hardwood lumber, pointed end, reasonably free of knots.
- C. Tree Straps: Nylon, polypropylene, or similar ¾" – 1" wide woven cloth.
- D. Insecticide Solution: Solution mixed in accordance with manufacturer's recommendations. Submit product name to the Landscape Architect for approval.
- E. Subdrainage: Corrugated Acrylonitrile Butadiene Styrene (ABS), ASTM/ANSI D2282; or approved equal.
- D. Filter Fabric For Subsurface Drainage: Mirafi 140N by Mirafi, Inc. or Typar 3301 Geotextile by Dupont or approved equal.
- E. Landscape Edging: Aluminum edging (CRD2), 4 inch x 1/8 inch; color: black anodized finish; manufactured by Curv-rite Aluminum Edging, Byron Center, MI, (800) 366-2827 or Permaloc Aluminum Edging, Holland, MI, (616) 399-9600.

PART 3 EXECUTION

3.1 PREPARING PLANT PIT

- A. Walls of pit shall be dug so that they are vertical and scarified.
- B. The pit must be a minimum of 12 inches larger on every side than the ball of the plant.
- C. The pit shall be excavated to a depth to allow 1/8 of the ball to be above the existing grade.
- D. All shrub beds will be excavated to a depth of 18" and backfilled with the specified plant mix.

- E. Dispose of all undesirable excavated material such as clay, sod, stone, etc. off site.
- F. Saturate pits with water to test drainage. If poor drainage conditions exist, notify Landscape Architect or Owner immediately. Modifications in planting methods may be required, including increase in planting hole width and setting root balls higher above finish grade.
- G. Verify that required underground utilities are available, in proper location, and ready for use.

3.2 PLACING PLANT IN PIT

- A. Place the plant in the pit either by lifting and carrying the plant by its ball (never lift by branches or trunk) and then lowering it into the pit.
- B. Remove burlap from top 1/3 of ball (folding it back down the side of the ball will be acceptable).
- C. Cut and remove wire basket from rootball cut all twine away from trunk.
- D. Set the plant straight and in the center of the pit with the most desirable side of the shrub or tree facing toward the prominent view (sidewalk, building, street, etc.)

3.3 BACKFILLING PLANT PIT

- A. Backfill plant pit with a soil mixture consisting of 1/3 excavated soil from plant pit, 1/3 imported top soil and 1/3 organic material.
- B. Mix soil amendments in mixture either prior to filling pit or as pit is being filled.
- C. Make sure plant remains straight during backfilling procedures.
- D. Backfill sides of pit halfway with soil mixture and tamp as pit is being filled.
- E. Finish backfilling sides of pit and tamp firmly.
- F. Never cover top of ball with soil.
- G. Form a saucer above existing grade and around the outer rim of the pit.
- H. Mulch top of rootball and saucer within 48 hours to a minimum depth of 2 inches and to a depth not to exceed 3 inches.

- I. Water thoroughly on the interior of the saucer until it is filled even if it is raining. A second watering may be necessary to insure saturation of the root ball.
- J. Prune any dead or broken branches.
- K. Remove all tags, labels, strings, etc. from the plant.

3.4 STAKING

- A. Staking support shall not be installed on normal planting sites, however, where wind conditions are extreme and the Contractor feels staking is required, install stakes as follows:
 - 1. Trees shall be supported immediately after planting.
 - 2. Wires and cables shall be encased in hose and placed at a minimum of 1/3 of tree height or above the lowest stout branch.
 - 3. Brace plants vertically with wrapped guy wires and stake with 1 stake on the windward side.
 - 3. Drive stakes until firm footing is achieved, two foot minimum depth. Do not drive stakes through root ball.
- B. The Landscape Contractor shall be responsible for maintaining the tree in an upright position and shall be responsible for any damage to trees that have blown over during the 1-year warranty period. If the Landscape Contractor observes that trees may require more support than specified, then the Contractor should confer with the Owner.

3.5 PERENNIALS/GROUND COVER PLANTING

- A. Preparation of plant bed: Entire plant bed shall be cultivated to a minimum depth of 18". One inch or approved organic matter and commercial fertilizer at a rate of 4 lbs./1000 sf shall be spread over entire area. These soil amendments shall be thoroughly tilled into the top 6" of the planting bed.
- B. Planting: Before planting, biodegradable pots shall be crushed and nonbiodegradable pots shall be removed. Root systems of all potted plants shall be split or crumbled. The plant material shall be placed so that the entire root system is surrounded by soil. Potted plants shall be set with the top of pot even with finished grade, bare root plants shall be covered up to the crown of the plant.
- C. Mulch: The entire bed shall be mulched to a depth of 2" .

3.6 BULBS

- A. Plant bulbs at equal depths appropriate to the specie and space at an equal distance as shown. All bulbs should have a minimum amount of soil covering the top of the bulb equal to two times the diameter of the bulb.
- B. Add bone meal (4-8 lbs/100 sq. ft. of bed area) to the bottom of each bulb hole as recommended by the grower or supplier.
- C. Mulch and thoroughly water all beds.

3.7 CLEAN UP

- A. During landscape installation, all areas shall be "broom" clean at the end of each workday. Sidewalks and other paved areas shall be swept or washed down as needed.
- B. Following completion, all debris, soil and trash resulting from landscape operations shall be removed from the site. All paved areas shall be washed down.

3.8 MAINTENANCE

- A. Begin maintenance immediately after planting, and continue until initial acceptance.
- B. Maintain trees, shrubs and other plants by pruning, cultivating and weeding as required for healthy growth. Watering to include a thorough initial watering, with weekly waterings thereafter for the first 30 days. Waterings thereafter shall continue on a bi-weekly basis or as necessary to maintain plants in healthy conditions. The total number of waterings shall be twenty-six (26) at the Owner's discretion.

END OF SECTION 329300

SECTION 329400 - TREE PROTECTION AND TRIMMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. City of Rockville approved Forest Conservation Plan and Permit.

1.2 SUMMARY

- A. This Section includes the protection and trimming of existing trees that interfere with, or are affected by, execution of the Work, whether temporary or permanent construction.
- B. Related Sections include the following:
 - 1. Division 1 Section "Summary" for limits placed on Contractor's use of the site.
 - 2. Division 1 Section "Temporary Facilities and Controls" for temporary tree protection.
 - 3. Division 31 Section "Site Clearing" for removal limits of trees, shrubs, and other plantings affected by new construction.
 - 4. Division 31 Section "Earthwork" for building and utility trench excavation, backfilling, compacting and grading requirements, and soil materials.
 - 5. Division 32 Section "Exterior Plants" for tree and shrub planting, tree support systems, and soil materials.

1.3 DEFINITIONS

- A. Tree Protection Zone: Area surrounding individual trees or groups of trees to remain during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated. Additional tree protection zones are those areas enclosed by tree protection fence, installed in the location and manner shown on the plans.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Tree Pruning Schedule: Written schedule from arborist detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
 - 1. Species and size of tree.
 - 2. Location on site plan. Include unique identifier for each.
 - 3. Reason for pruning.
 - 4. Description of pruning to be performed.

5. Description of maintenance following pruning.

C. Qualification Data: For tree service firm and arborist.

D. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

E. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work. Additional recommendations are shown on the forest conservation plan.

1.5 QUALITY ASSURANCE

A. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of tree protection and trimming.

B. Arborist Qualifications: An arborist certified by ISA and licensed in the jurisdiction where Project is located.

C. Tree Pruning Standard: Comply with ANSI A300 (Part 1), "Tree, Shrub, and Other Woody Plant Maintenance--Standard Practices (Pruning)."

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Before tree protection and trimming operations begin, meet with representatives of authorities having jurisdiction, Owner, Architect, consultants, and other concerned entities to review tree protection and trimming procedures and responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D 448, Size 24, with 90 to 100 percent passing a 2-1/2-inch sieve and not more than 10 percent passing a 3/4-inch sieve.

B. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch in diameter; and free of weeds, roots, and toxic and other nonsoil materials.

1. Obtain topsoil only from well-drained sites where topsoil is 4 inches deep or more; do not obtain from bogs or marshes.

- C. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.
- D. Chain-Link Fence: Metallic-coated steel chain-link fence fabric of 0.120-inch-diameter wire; a minimum of 48 inches high; with 1.9-inch-diameter line posts; 2-3/8-inch-diameter terminal and corner posts; 1-5/8-inch-diameter top rail; and 0.177-inch-diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
- E. Galvanized Wire Mesh, etc. per City of Rockville regs.
- F. Organic Mulch: Shredded, well-aged hardwood bark, free of deleterious materials.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Temporary Fencing: Install temporary fencing around tree protection zones to protect remaining trees and vegetation from construction damage. Keep temporary fencing in place and in good repair for the entire duration of construction. Maintain temporary fence and remove when construction is complete.
 - 1. Install tree protection fence as indicated on the plans.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Mulch areas inside tree protection zones and other areas indicated.
 - 1. Apply 3-inch average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks.
- D. Do not store construction materials, debris, or excavated material inside tree protection zones. Do not permit vehicles or foot traffic within tree protection zones; prevent soil compaction over root systems within tree protection zones.
- E. Maintain tree protection zones free of weeds and trash.
- F. Do not allow fires within tree protection zones.

3.2 EXCAVATION

- A. Install shoring or other protective support systems to minimize sloping or benching of excavations.
- B. Do not excavate within tree protection zones, unless otherwise indicated.

- C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks and comb soil to expose roots.
 - 1. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction.
 - 2. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
- D. Where utility trenches are required within tree protection zones, tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand.
 - 1. Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp, clean pruning instruments; do not pull, tear, break or chop.

3.3 REGRADING

- A. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade beyond tree protection zones. Maintain existing grades within tree protection zones.
- B. Minor Fill: Where existing grade is 3 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations. Keep all fill at least 3 feet from any tree trunk.

3.4 TREE PRUNING

- A. Prune trees to remain that are affected by temporary and permanent construction.
- B. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist and as shown on Forest Conservation Plan.
- C. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
- D. Cut branches with sharp, clean pruning instruments; do not break or chop.
- E. Chip removed tree branches and dispose of off-site.

3.5 TREE REPAIR AND REPLACEMENT

- A. Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to arborist's written instructions.

- B. Remove and replace trees indicated to remain that die or are damaged during construction operations to such an extent that Landscape Architect determines they are incapable of recovering to normal growth patterns.
 - 1. Provide new trees of same size and species as those being replaced; plant and maintain as specified in Division 2 Section "Exterior Plants."
- C. Aerate surface soil, compacted during construction, 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch-diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

3.6 DISPOSAL OF WASTE MATERIALS

- A. Burning is not permitted.
- B. Disposal: Remove excess excavated material and displaced trees from Owner's property.

END OF SECTION 329400

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. City of Rockville approved Stormwater Management Plans and Permit.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Nonpressure transition couplings.
 - 3. Cleanouts.
 - 4. Drains.
 - 5. Manholes.
 - 6. Catch basins.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Manholes: Include plans, elevations, sections, details, frames, and covers.
 - 2. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

- E. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
- F. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. PVC Gravity Sewer Piping:
 - 1. Pipe and Fittings: ASTM D 3034 SDR 35 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

2.2 CONCRETE PIPE AND FITTINGS

- A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.
 - 1. Bell-and-spigot ends and rubber gaskets.

2.3 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.

C. Unshielded, Flexible Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco Inc.
 - c. Logan Clay Pipe.
 - d. Mission Rubber Company; a division of MCP Industries, Inc.
 - e. NDS Inc.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
2. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

2.4 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
3. Top-Loading Classification(s): Light Duty.
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. Plastic Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Canplas LLC.

- b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.
2. Description: PVC body with PVC threaded plug. Include PVC Sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.5 DRAINS

A. Cast-Iron Trench Drains:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
2. Description: ASME A112.6.3, 6-inch- wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular grate. Include units of total length indicated and quantity of bottom outlets with inside calk or spigot connections, of sizes indicated.
3. Top-Loading Classification(s): Heavy Duty.

2.6 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478 precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990 bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923 cast or fitted into manhole walls, for each pipe connection.
9. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow worker to place both feet on one step and

designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.

10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48/A 48M, Class 35 gray iron unless otherwise indicated.

2.7 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R , and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope 2" per foot through manhole, unless otherwise indicated.
2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 2 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.8 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
8. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
9. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

- #### A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

- #### A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- #### B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves,

and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow.
 - 2. Install piping with 24 minimum cover.
 - 3. Install PVC water-sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 4. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
 - 2. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
 - 3. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
 - 1. Use Light-Duty, top-loading classification drains in earth or unpaved foot-traffic areas.
 - 2. Use Medium-Duty, top-loading classification drains in paved foot-traffic <areas.
 - 3. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.
- B. Embed drains in 4-inch minimum concrete around bottom and sides.
- C. Fasten grates to drains if indicated.
- D. Set drain frames and covers with tops flush with pavement surface.
- E. Assemble trench sections with flanged joints.
- F. Embed trench sections in 4-inch minimum concrete around bottom and sides.

3.6 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.7 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.8 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.9 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."
- B. Connect force-main piping to building's storm drainage force mains specified in Division 22 Section "Facility Storm Drainage Piping." Terminate piping where indicated.

- C. Make connections to existing piping and underground manholes.
 - 1. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 2. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Unshielded/Shielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 - 2. Use pressure-type pipe couplings for force-main joints.

3.10 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
 - 1. Remove manhole or structure and close open ends of remaining piping.
 - 2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Division 31 Section "Earth Moving."

3.11 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.12 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate report for each test.
 5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.
 - c. Option: Test concrete piping according to ASTM C 924.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.13 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

3.14 STORMWATER MANAGEMENT

- A. The construction of all Stormwater Management facilities shall conform to the approved drawings, Montgomery County Stormwater Management construction standards, MDE Stormwater Design Manual Volumes I&II, and the State of Maryland Highway Standard Specifications. The Contractor is responsible for fully understanding the design and function of the proposed facilities and for constructing facilities in full compliance with design standards. The Contractor shall ensure that all of the required plan checklists are signed by the appropriate individuals at the required stages of construction. The Contractor shall verify all critical inverts and elevations throughout construction to verify conformance with the design and standards. This information shall be provided to the Owner and the Engineer-In-Charge at stages during construction as determined in the field for each individual project. Any adjustments to the construction of the facilities shall be reviewed and approved by the Engineer-In-Charge and MCDPS. Approval of the modifications is required prior to proceeding with construction. The Contractor shall make any corrections and adjustments required to fully provide required design volumes, function, and structural integrity of facilities at no additional cost to the owner. The Contractor shall also verify that all site improvements, flow paths, and drainage areas to each facility are in conformance with the approved design plans. The Contractor is responsible for providing As-Built plans and appropriate support documentation to the Owner and the Engineer-In-Charge. The Contractor shall make any and all repairs and/or modifications required to obtain As-Built approval by MCDPS and final release of permit at no additional costs to the owner. The Contractor shall be solely responsible for maintenance of all stormwater-related facilities until final acceptance of the facilities by MCDPS, and shall perform full cleanout and/or dredging of facilities prior turn over to the owner.

END OF SECTION 334100



Montgomery College
endless possibilities

**Montgomery College - Rockville Campus
Science West Renovation & Addition**

Reference Documents, Not for Bid

Geotechnical Information – Volume IV (4 of 4)

February 19, 2014

MHEC Project No. CC-01-414

MC Contract No. 533

Stantec Project No: 218310092

Reference Documents, Not for Bid

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271513	COMMUNICATIONS COPPER HORIZONTAL CABLING
271533	COMMUNICATIONS CABLE TELEVISION CABLING AND EQUIPMENT
271543	COMMUNICATIONS FACEPLATES AND CONNECTORS
271619	COMMUNICATIONS PATCH CORDS, STATION CORDS, AND CROSS CONNECT WIRE
275100	DISTRIBUTED AUDIO-VISUAL COMMUNICATION, SECURITY SUPPLEMENT

DIV. 28 ELECTRONIC SAFETY AND SECURITY

280500	COMMON WORK RESULTS FOR ELECTRONIC SECURITY
280513	CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY
281300	ACCESS CONTROL
282300	VIDEO SURVEILLANCE
283111	DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

DIV. 31 EARTHWORK

311000	SITE CLEARING
312000	EARTH MOVING
313116	TERMITE CONTROL

DIV. 32 EXTERIOR IMPROVEMENTS

321313 CONCRETE PAVING
321400 UNIT PAVERS
329200 SEEDING AND SODDING
329300 TREES, SHRUBS AND GROUND COVERS
329400 TREE PROTECTION AND TRIMMING

DIV. 33 UTILITIES

334100 STORM UTILITY DRAINAGE PIPING

VOLUME IV

000900 GEOTECHNICAL INFORMATION

GEOTECHNICAL ENGINEERING REPORT

SCIENCE WEST BUILDING ADDITIONS – MONTGOMERY COLLEGE MANNAKEE STREET, ROCKVILLE, MARYLAND

Schnabel Reference No. 11612077
January 26, 2012





January 26, 2012

Ms. Andrea Feniak
Stantec
1056 Thomas Jefferson Street NW
Washington, DC 20007

**Subject: Project 11612077, Geotechnical Engineering Report,
Science West Building Additions – Montgomery College,
Mannakee Street, Rockville, Maryland**

Dear Ms. Feniak:

SCHNABEL ENGINEERING CONSULTANTS, INC. (Schnabel) is pleased to submit our geotechnical engineering report for this project. This report includes attached figures and appendices with relevant data collected for this study. This study was performed in accordance with our revised proposal dated November 3, 2011, as authorized by you on November 16, 2011. A report for the upcoming on-site geophysical (MASW) services to be completed by our office will be provided under separate cover.

SCOPE OF SERVICES

Our scope of services herein includes the following:

1. Evaluation of estimated subsurface conditions within the proposed staircase and proposed building additions based on the soil testing borings, the test pit observations, and the hand augering and DCP testing.
2. Recommended foundation requirements for support of the building additions and floor slabs-on-grade. Estimates of total and differential settlements between adjacent existing footings and between existing and new footings are also provided herein and are based on loading information supplied by the structural engineer.
3. Comments on the feasibility of adding new loads to existing footings along Column Line No. 13 for the proposed East Addition based on nearby borings and test pits and based on loading information provided by the structural engineer.
4. Recommended lateral earth pressure diagrams for use in design of building walls below-grade, where necessary.
5. Recommendations regarding handling of groundwater in design.

6. Recommendations for construction of load bearing fills including an assessment of on-site soils to be excavated for use as fill.
7. Comments regarding geotechnical construction considerations for use in the design and construction plans and specifications.

Services not described in our proposal/agreement are not included in this study. We would be happy to provide additional geotechnical-related support services to the design team as the project demands, including construction dewatering, review of geotechnical aspects of the project plans and specifications; construction phase observation and testing services and environmental services, etc. An additional report including the results of our on-site geophysical (MASW) investigation and our recommended seismic soil site class per IBC 2009 will be provided under separate cover.

SITE DESCRIPTION AND PROPOSED CONSTRUCTION

The existing two-story Science West Building at the Rockville, Maryland campus is located east of Campus Drive West, north of the large pond, and is surrounded by relatively flat grass/green areas and concrete walkways. A Site Vicinity Map is included as Figure 1. Based on as-built drawings provided by your office, we understand that the lowest level top-of-slab elevation of the existing building is at about El 422.33. Per the drawings, the building is supported on spread footings with bottom elevations ranging from about El 408 to El 417.33. Therefore, footing bottoms extend from about 5 ft up to about 14 ft below the existing floor slab. Based on topographic plans provided by AMT LLC, existing grades surrounding the building are relatively flat and range from about El 420 to El 422. We understand that an additional floor will be added to the existing Science West Building in the near future (not part of this scope/report) and that the existing footings were originally designed to support the planned third floor level.

We understand that new stairs, a new elevator and a replacement wedge of the existing structure are proposed for the Science West Building. A new stair structure will be built at the northwestern corner of the existing building (hereafter, NW Addition) and a new stair/elevator/lobby structure will be located at the southwest corner of the building (hereafter, SW Addition) following the demolition of the existing southwest stair structure in the area. Both the NW Addition and SW Addition will be three levels above grade and will have a lowest level floor slab elevation of El 421.33 (matching existing building). We understand the NW Addition will be structurally connected to the existing building, whereas the SW Addition will be structurally independent from the existing building by expansion joint(s). A building plan showing the location of the NW Addition and the SW Addition is included herein as Figure 2. We understand that three new columns are planned for the NW Addition and that two new columns and CMU walls are planned for the SW Addition. Due to the variable depth of the existing footings at the location of the SW Addition and also due to the anticipated top-of-slab elevation of the elevator pit at about El 417, we understand that underpinning of some existing footings will be required in this area. The following table includes some of the structural details for the proposed and modified foundations for the NW and SW Additions.

Table 1: Summary of Structural Details for NW Addition/SW Addition Foundations

Proposed Structure	Column Location (Status)	Existing Footing Design Load	Existing Footing Dimensions	Proposed Footing Load	Existing Footing Bottom Elevation
NW Addition	A.5/2.2 (New Column)	N/A	N/A	20 kips	N/A
	A.2/2.5 (New Column)	N/A	N/A	30 kips	N/A
	A.2/3.3 (New Column)	N/A	N/A	50 kips	N/A
	B/2 (Existing Column)	108 kips	7 ft x 7 ft	110 kips	EI 416.83
	B/3 (Existing Column)	121 kips	7.5 ft x 7.5 ft	125 kips	EI 416.83
	B/4 (Existing Column)	110 kips	7 ft x 7 ft	110 kips	EI 416.83
	A/4 (Existing Column)	35 kips	4 ft x 4 ft	45 kips	EI 417.83
SW Addition	K.8/2.5 (New Column)	N/A	N/A	100 kips	N/A
	K.5/3.9 (New Column)	N/A	N/A	90 kips	N/A
	1.5-3/J.1-J.7 (New CMU Walls)	N/A	N/A	6 kips/ft & 10 kips/ft	N/A
	J/1 (Existing Column)	41 kips	4.3 ft x 4.3 ft	45 kips	EI 410.0
	J/2 (Existing Column)	122 kips	7.5 ft x 7.5 ft	125 kips	EI 413.5 *
	J/3 (Existing Column)	203 kips	9.5 ft x 9.5 ft	205 kips	EI 417.33 *
	J/4 (Existing Column)	174 kips	8.5 ft x 8.5 ft	175 kips	EI 417.33
	K/4 (Existing Column)	148 kips	8 ft x 8 ft	150 kips	EI 416.58

* - Underpinning of Footing Anticipated due to Existing Bottom Elevation of Adjacent Footing at J/1.

Based on recent communications with the structural engineer, we understand that current loads exerted on the above footings are approximately 2/3 of the Existing Footing Design Loads provided in the third column in the table above.

We understand that a replacement building wedge will be constructed along the east side of the Science West Building (hereafter, East Addition) following the demolition of the existing two-story wedge and adjacent elevated pedestrian bridge. The East Addition will be three levels above grade and will have a lowest level floor slab elevation of EI 421.33 (matching existing building to west). A building plan showing the location of the East Addition is included herein as Figure 3. At the time of our on-site investigation, we understood that existing footings along building Column Line No. 14 would be used to support part of the East Addition whereas existing footings east of Column Line No. 14 would be removed and replaced with new foundations for the East Addition. Based on recent communications with the structural engineer, however, we currently understand that all existing footings east of Column Line No. 13 will be completely removed and replaced with new foundations for the East Addition. We also understand that the west side of the East Addition will be supported on the existing footings along building Column Line No. 13 and that the East Addition will be structurally connected to the existing building at Column Line No. 13. Based on the structural details, loads of the new footings for the East Addition will range from about 40 kips to about 135 kips. The following table includes a summary of some of the structural details of the existing footings along Column Line No. 13 that may support the west side of the East Addition.

Table 2: Summary of Structural Details of Column Line 13 Footings Supporting East Addition

Proposed Structure	Column Location	Existing Footing Design Load	Existing Footing Dimensions	Proposed Footing Load	Existing Footing Bottom Elevation
East Addition	A/13	35 kips	4 ft x 4 ft	45 kips	El 414.66
	B/13	145 kips	8 ft x 8 ft	145 kips	El 416.58
	D/13	204 kips	9.5 ft x 9.5 ft	205 kips	El 417.33
	F/13	173 kips	8.5 ft x 8.5 ft	175 kips	El 417.33
	H/13	172 kips	8.5 ft x 8.5 ft	175 kips	El 417.33
	J/13	163 kips	8.5 ft x 8.5 ft	170 kips	El 416.58
	K/13	122 kips	7.5 ft x 7.5 ft	125 kips	El 416.83

Based on recent communications with the structural engineer, we understand that current loads exerted on the above footings are approximately 2/3 of the Existing Footing Design Loads provided in the third column in the table above.

We obtained the site information from your office and through our site visits. The structural engineer, A+F Engineers, provided the project details and structural load information.

SUBSURFACE CONDITIONS

Data Collection Techniques

A total of six soil test borings were drilled at the site along the exterior of the Science West Building. Borings B-1 and B-2 were drilled at the location of the SW Addition, borings B-3 and B-4 were drilled at the location of the NW Addition, and borings B-5 and B-6 were drilled, respectively, on the south and north sides of the East Addition. The six borings were drilled to depths ranging from 35 ft to 45 ft below existing surface grades. The soil test boring logs with groundwater observation data are included in Appendix A at the end of this report.

In addition to the soil test borings, two test pits were excavated at existing footings along Column Line 14 to expose the subgrades below the two footings. Test Pit TP-1 was excavated at the footing located at J/14 along the southeast side of the building and test pit TP-2 was excavated at the footing located at B/14 along the northeast side of the building. TP-1 was excavated using a back-hoe whereas TP-2 was excavated by hand. Hand auger and DCP testing to a depth of about 2 ft below the bottom of footing J/14 and to a depth of about 5 ft below the bottom of footing B/15 were performed at the bottom of the test pits. The hand auger logs for the two test pits along with the test pit cross sections are provided in Appendix C.

The recent and previous soil boring locations and the recent test pit and hand auger locations are approximated on Figure 4.

Our geotechnical laboratory conducted tests on selected samples obtained during our investigation. This testing aided in the classification of the soils encountered in the subsurface exploration. Soil laboratory test results are included in Appendix B. The logs in Appendix A show the natural moisture content

values, sieves and Atterberg limits results of selected soil samples. We will retain soil samples for up to 45 days beyond the issuance of this report, unless you request other disposition.

Generalized Subsurface Stratigraphy

The subsurface data from the recent soil test borings indicate the following generalized soil strata underlie the site to the depths investigated at the boring locations. The strata designations do not imply continuity of materials described, but reflect the general description and characteristics of the subsurface materials at the site:

Ground Cover:

Up to about 2 inches of topsoil and up to about 11 inches of concrete over gravel was encountered at the soil test boring locations. These depths may vary at other locations at the site.

Stratum A: Fill

Fill and Probable Fill soils generally consisting of sandy silt and clayey sand containing various amounts of roots, mica, rock fragments and gravel, was encountered below the ground surface to depths of about 2.5 ft to 8.5 ft below existing grades. Based on Standard Penetration Test (SPT) results, this stratum is generally loose in consistency (SPT values varied from 4 blows per ft to 43 blows per ft).

Stratum B: Residual (Low Plasticity)

Below the fill soils of Stratum A, the borings encountered residual soils consisting of various shades of brown SANDY SILT (ML) and WELL GRADED SAND WITH GRAVEL (SW), containing various amounts of mica and quartz rock fragments to depths of about 18.5 ft to about 43.5 ft below existing grades. Based on the SPT results, this stratum is generally loose to dense (SPT values varied from 5 blows per ft to 54 blows per ft).

Stratum C: Residual (High Plasticity)

Below the fill soils of Stratum A, boring B-2 encountered residual soil consisting of orangish-brown to reddish-brown ELASTIC SILT WITH SAND (MH), containing trace amounts of mica to a depth of about 8.5 ft below the ground surface at this location. Based on the SPT results, this stratum is generally soft (SPT values varied from 5 blows per ft to 8 blows per ft).

Stratum D: Residual (Disintegrated Rock)

Below and interlayered with the Stratum B soils, residual soil consisting of light brown and yellowish brown DISINTEGRATED ROCK, sampled as sandy silt and silty sand, containing trace amounts of mica and rock fragments was encountered. Based on the SPT results, this stratum is very dense (SPT values varied from 63 blows per ft to 100 blows per 2 inches penetration).

The above stratification is shown in detail on the boring logs in Appendix A. The sampling procedures used to determine SPT values are also presented in Appendix A.

Disintegrated rock is defined as residual material with N values in excess of 60 blows per ft and less than 100 blows for 2 inches of penetration. Refusal is defined as 100 blows per 2 inches or less penetration.

The soil group symbols indicated on the boring logs and in the generalized subsoil stratum descriptions above represent the Unified Soil Classification System (USCS) group symbols and are based on visual identification of soil specimens recovered, per ASTM D-2488. The criteria for visual identification of soil specimens are presented in Appendix A. It should be noted that there may be a difference between visual classifications and laboratory classifications based on ASTM D-2487.

Test Pit and Hand Auger Observations

Two test pits were excavated and hand augers were advanced by Schnabel personnel at the approximate locations shown in the attached Test Boring and Test Pit Location Plan (Figure 4). The excavated material was used to backfill the test pit and hand augers using minimal compaction. The test pit logs and cross sections are included in Appendix C.

The excavations for test pits TP-1 and TP-2 extended to depths of approximately 7.5 ft and 5.7 ft, respectively, below existing surface grades. The southwest corner of the existing footing at column J/14 (at TP-1) and the northwest corner of the existing footing at column B/14 (at TP-2) were exposed and observed. The as-built plans indicate a bottom of footing elevation for footing J/14 (at TP-1) at El 416.83 and that the footing is approximately 6 ft by 9.5 ft in area (combined footing). For footing B/14 (at TP-2), the plans indicate a bottom of footing elevation at El 417.33 and that the footing is approximately 8 ft by 8 ft in area. Our footing measurements in the field corresponded to the footing dimensions provided by the as-built plans. We advanced a hand auger and performed DCP testing adjacent to the footings starting at about the footing subgrades. The test pit cross sections (see Appendix C) provide measurements of observed foundation conditions.

The soils above the bottom of the footings were fill soils generally described as sandy silt with varying amounts of roots, mica, rock fragments, boulders, gravel and rock fragments. The hand auger and DCP data indicated residual soils consisting of various shades of brown sandy SILT (ML) and silty SAND (SM), containing varying amounts of mica and rock fragments. Based on the DCP test results, these soils were generally firm to very dense (DCP values varied from 14 blow per 1¼ inches and 50 blows per 1 inch) at the test pit locations. The hand auger and DCP data are provided on the hand auger logs in Appendix C. No groundwater was encountered during test pit excavating or hand augering.

Geology

The fill of Stratum A is believed to be associated with construction of the existing Science West Building and past grading at the site. These soils are underlain by residual soils (Strata B and C) derived from chemical weathering of the bedrock at the site. The bedrock at the site is believed to be schist of the Wissahickon Formation.

Groundwater

Groundwater level measurements were taken in the soil borings during drilling, upon completion of drilling, and either at the end of the day drilling was completed (in borings B-2, B-5, and B-6), or 24-hours after the completion of drilling (in borings B-1, B-3 and B-4) prior to backfilling the holes and demobilizing off-site. Groundwater was initially encountered in the borings between depths from about 15 ft to 23.5 ft below surface grades, or between about El 397.5 and El 405. Upon completion of drilling, groundwater was observed between depths from about 11.7 ft to 21.8 ft below surface grades, or between about El 399.2 and El 408.3. Long term water level readings (either end-of-day or 24-hours after completion of drilling) indicated groundwater was present between depths from about 11 ft to 21.6 ft below surface grades, or between about El 399.4 and El 409. Groundwater was not encountered at the test pit/hand auger locations. The final design should anticipate fluctuations in the groundwater level depending upon variations in precipitation, the nearby SWM pond, surface runoff, pumping, nearby buildings, leaking utilities, time of year and other similar factors.

GEOTECHNICAL RECOMMENDATIONS

We based our geotechnical engineering analysis on the information developed from our recent and previous subsurface investigations along with the proposed structural loading provided to us by A+F Engineers. The three additions to the Science West Building (NW Addition, SW Addition, and East Addition) will have a lowest level top-of-slab elevation at about El 422.33, matching the lowest level of the existing structure. The top-of-slab elevation of the new elevator pit (at SW Addition) will be at about El 417. Based on the available soil test boring and test pit data and based on the anticipated loads for the new footings (see Tables 1 and 2 above), we believe that new footings for the NW Addition, the SW Addition, and the East Addition can be supported on shallow spread footings founded on the firm undisturbed natural soils of Stratum B for an allowable soil bearing pressure of 3,000 psf. Some lowering of new footings to reach the firm natural undisturbed soils is anticipated to be required.

Based on the structural loading information provided to us by the as-built drawings for the existing spread footings located along building Column Line No. 13 (see Table 2 above), we estimate that the existing footings have experienced soil bearing pressures between about 1,445 psf and about 1,600 psf since the structure was completed in about 1969. Considering the new loads provided to us by the structural engineer (Table 2 above) for these footings, we estimate that the bearing pressure under the existing footings along Column Line No. 13 will range from about 2,200 psf to about 2,800 psf following the completion of the East Addition. Based on the information provided to us for this project, we believe that the existing spread footing foundations can support the new loads exerted by the East Addition.

The following sections of the report provide our detailed recommendations.

Spread Footings (New Foundations)

Shallow spread footings are considered to be suitable for support of the proposed NW Addition, SW Addition, and East Addition to the Science West Building. New footings should be supported on suitable firm natural soils of Stratum B. The footings may be designed for a net allowable soil bearing pressure of 3,000 pounds per square foot (psf). We have estimated highest footing subgrade elevations at the applicable boring locations for the three additions as follows:

Table 3: Estimated Highest Footing Subgrade Elevations

Proposed Structure	Boring Number	Estimated Highest Footing Subgrade Elevation (ft) for a Bearing Pressure of 3,000 psf
SW Addition	B-1	EI 418
	B-2	EI 412
NW Addition	B-3	EI 417
	B-4	EI 415
East Addition	B-5	EI 411
	B-6	EI 415

The estimated subgrade elevations given above are for design purposes only and should be adjusted based on floor grades, utilities, structural requirements, etc. Bearing grades between borings may be set by linear interpolation. The adequacy of the footing subgrade soils should be determined by a qualified Geotechnical Engineer during construction. Design grades and design pressures may have to be adjusted in the field, based on the actual conditions encountered.

In the areas of borings B-2 and B-5, excessive lowering is expected. In lieu of lowering these footings to the elevations given in Table 3 above, the undercut soils can be backfilled with AASHTO No. 57 crushed stone, lean concrete, or with new compacted structural fill and the footings can be placed at normal footing depths below the floor slab.

Column and wall footings should be at least 30 inches and 16 inches wide, respectively, for shear considerations. Exterior footings should be founded at least 2.5 ft below final exterior grades for frost protection. Interior footings may be founded at nominal depths below the floor slabs, provided that interior areas will be heated. A maximum allowable slope of 1.5 horizontal to 1 vertical (1.5H:1V) should be maintained between the bottom edges of adjacent footings. New footings should be founded at the same level as adjacent existing footings. Underpinning of adjacent footings is anticipated to be required in areas but this depends on the proximity and bottom elevations of the existing and proposed footings.

Total footing settlement and differential settlement between new and existing foundations is not expected to exceed about ½ inch for the NW Addition, the SW Addition, and the East Addition. Lowering of footings and undercutting of unsuitable soils is expected to be required in areas where soils are soft and/or disturbed.

It should be noted that demolition and removal of the existing foundations in the areas of the proposed SW Addition and East Addition is expected to disturb the subgrade soils. Care should be taken to minimize disturbance beyond the locations of the existing footing being removed.

Spread Footings (Existing Foundations)

Based on the structural loading information and footing dimensions provided to us for the project (see Table 2 above), we estimate that the existing footings along Column Line No. 13 have experienced soil bearing pressure between about 1,445 psf and about 1,600 psf since the structure was completed in about 1969. Considering the proposed loads, we estimate that the bearing pressure below the existing

footings will range from about 2,200 psf to about 2,800 psf following the completion of the East Addition. Therefore, the footings will experience an increase in bearing pressures of up to about 1,355 psf. We believe that the existing spread footing can support the new loads. Based on the new loads and considering the close proximity of the footings to each other, we expect additional settlements to be minor and these settlements are not expected to exceed about ½ inch for the columns along Column Lines 13.

Floor Slabs

Firm existing fill soils of Stratum A, the natural soils of Stratum B or new compacted structural fill may be suitable for support the floor slabs. A modulus of subgrade reaction, k, of 150 kcf may be used in design of floor slabs.

The contractor should re-compact floor slab subgrades immediately before placing moisture barrier materials to repair any disturbance that may occur due to construction operations. Backfilling of footing and utility excavations should use compacted structural fill since floors will be slab-on-grade. Compaction requirements are the same as described herein for compacted structural fill.

A minimum 4-inch thick washed gravel or crushed stone capillary moisture barrier should underlie the floor slabs-on-grade. The moisture barrier material should meet the requirements for AASHTO No. 57 crushed stone. The contractor should compact the stone in place by at least two passes with suitable vibratory compaction equipment. A 10-mil thick polyethylene liner should be installed over the crushed stone layer as a vapor barrier and to prevent concrete intrusion into the stone.

Seismic Site Classification

A report detailing the on-site shear wave velocity data based on a separate on-site geophysical (MASW) investigation will be provided under separate cover. The site class will be provided based on the geophysical (MASW) investigation and according to IBC 2009.

Earthwork and Grading

Compacted structural fill and backfill in building areas should consist of material classifying as ML, SC, SM, SP, SW, GC, GM, GP or GW per ASTM D-2487 with liquid limits and plastic indexes of less than 40 and 20, respectively. The maximum permissible particle size in compacted fills is 3 inches. Soil moisture contents should be within 3 percent of the soils optimum moisture content. On-site soils of Strata B and D, if available, are expected to meet the compacted structural fill criterion. The Elastic Silt soils of Stratum C are not considered suitable for re-use as compacted structural fill or backfill. Based on our borings and test pit observations and the deleterious material encountered within the existing fill, we do not recommend the re-use of Stratum A soils as backfill or structural fill. Compacted structural fill should be placed in maximum 8-inch thick horizontal, loose lifts. Fill should be compacted to at least 95 percent of the maximum dry density per ASTM D-698 (Standard Proctor).

Successful re-use of the excavated, on-site soils as compacted structural fill will depend on their natural moisture contents during excavation. Site soils may be wet and scarifying and drying of the on-site soils will be required in order to achieve the recommended compaction. Drying of these soils will likely result in some delays and drying may not be possible during the late fall, winter and early spring. We recommend

that the earthwork be performed during the warmer, drier times of the year from about March to December.

The Geotechnical Engineer should evaluate the suitability of the site soils to receive new fill, based on observations of the bearing subgrades. The contractor should excavate excessively soft areas. Unsuitable soils should be replaced with new compacted structural fill or AASHTO No. 57 crushed stone.

Underpinning (Existing Foundations)

We understand that underpinning of some existing footings at the proposed location of the SW Addition may be required. The selection of underpinning will depend on many factors and we recommend a qualified specialty contractor experienced in the design and construction of underpinning be retained and that the contractor be responsible for the choice of underpinning for the existing footings.

We believe concrete pit type underpinning is feasible; however, we would expect difficulties during the installation of the underpinning pits due to possible cobbles/boulders in the residual soils within the footing subgrades and due to possible required dewatering of the pits. Also, the pits must extend to a competent bearing stratum. Underpinning pits may be designed for a soil bearing pressure of 3,000 psf when founded on the firm undisturbed natural soils of Stratum B. The magnitude of settlement from the underpinning will be dependent on the construction methods and sequence of underpinning.

SUBDRAINAGE RECOMMENDATIONS

We understand that the NW Addition, SW Addition, and East Addition will have a lowest level top-of-slab elevation at about El 422.33. Groundwater readings indicated the presence of groundwater below the lowest level of these three additions. Therefore; no special underfloor subdrainage will be required.

We understand that the top-of-slab elevation for the new elevator pit at the SW Addition will be at about El 417. Groundwater readings indicate the presence of groundwater between about El 402.4 (in boring B-1) and El 404.4 (in boring B-2), or about 12 ft to 14 ft below the bottom of the elevator pit and we do not believe that subdrainage will be required for the elevator pit.

LATERAL EARTH PRESSURES ON WALLS BELOW-GRADE (Elevator Pit for SW Addition)

The elevator pit at the SW Addition will be below final grades and the walls of the elevator pit should be designed to support lateral earth pressures. Considering a soil friction (Φ) angle of 30 degrees and a moist unit weight of 120 lb/ft³ for the backfill material, we recommend an equivalent fluid pressure of 50 H (where H is the height of the wall in ft). Figure 5 herein details the recommended lateral earth pressures for use in the design of elevator pit walls and assumes horizontal backfill behind the walls.

A friction factor of 0.3 may be used between the bottom of concrete and subgrade soils. An active pressure coefficient of $k_a = 0.33$, an at-rest pressure coefficient of $k_0 = 0.5$ and a passive pressure coefficient of $k_p = 3$ may be considered. Loading from surcharges, or sloping backfill above the walls need to be added to the equivalent fluid pressure provided above.

CONSTRUCTION CONSIDERATIONS

Spread Footing Subgrades

All footing subgrades should be observed by the Geotechnical Engineer to confirm that they are placed on suitable bearing materials as recommended herein. These observations should include visual identification of the bearing materials and correlation with the test boring logs. It may also be necessary to conduct field tests by probing with a penetrometer at selected locations. Should soft or unsuitable bearing materials be encountered within footing subgrades, the subgrades should be lowered to suitable bearing materials.

Care should be taken during excavation for footings to minimize disturbance of the subgrades soils. The footings should be excavated and poured the same day and excavations should be protected against softening from surface water infiltration. Disturbed, frozen or loosened bearing materials should be removed and the excavations should be essentially free of ponded water before placing concrete.

Forms may be used if necessary, but less subgrade disturbance is expected if excavations are made to the required dimensions and concrete is placed against the soil. If footings are formed, the forms should be pulled and the excavation backfilled as soon as possible. Water should not be allowed to pond along the outside of footings for long periods of time

Earthwork

The test boring data indicates the approximate depth of topsoil based on our visual identification procedures. The depth of stripping necessary to provide a suitable base for placement and compaction of earthwork may include topsoil and other softer surficial layers with or without organic matter. The depth of required stripping should be determined by the excavation contractor prior to construction using test pits, probes, or other means that the contractor wishes to employ, and this determination should be the excavation contractor's responsibility.

The on-site soils are susceptible to moisture changes, will be easily disturbed, and will be difficult to compact under wet weather conditions. Drying and reworking of the soils are likely to be difficult during wetter winter months. We recommend that the earthwork phases of this project be performed during the warmer, drier times of the year to limit the potential for disturbance of on-site soils.

Traffic on stripped or undercut subgrades should be limited to reduce disturbance of underlying soils. Also, using lightweight, track-mounted dozer equipment for stripping will limit the disturbance of underlying soils, and may reduce the undercut volume needed. The contractor should provide site drainage to maintain subgrades free of water and to avoid saturation and disturbance of the subgrade soils before placing compacted structural fill or moisture barrier material. This will be important during all phases of the construction work. The contractor should be responsible for reworking of subgrades and compacted structural fill that were initially considered suitable but were later disturbed by equipment and/or weather.

Engineering Services During Construction

The engineering recommendations provided in this report are based on the information obtained from the subsurface exploration and laboratory testing. However, conditions on the site may vary between the discrete locations observed at the time of our subsurface exploration. The nature and extent of variations between borings may not become evident until during construction.

To account for this variability, we should provide professional observation and testing of actual subsurface conditions revealed during construction as an extension of our engineering services. These services will also help in evaluating the contractor's conformance with the plans and specifications. Because of our unique position to understand the intent of the geotechnical engineering recommendations, retaining Schnabel for these services will allow us to provide consistent service throughout the project construction.

General Specification Recommendations

An allowance should be established to account for possible additional costs that may be required to construct earthwork and foundations, as recommended in this report. Additional costs may be incurred for a variety of reasons including variation of soil conditions between borings, greater than anticipated unsuitable soils, need for borrow fill material, wet on-site soils, groundwater, rock excavation, etc. The project specifications should indicate the contractor's responsibility for providing adequate site drainage during construction. Inadequate drainage could lead to disturbance of soils by construction traffic, which could result in the need to undercut disturbed soils.

This report may be made available to prospective bidders for informational purposes. We recommend that the project specifications contain the following statement:

Schnabel Engineering has prepared this geotechnical engineering report for this project. This report is for informational purposes only and is not part of the contract documents. The opinions expressed represent the Geotechnical Engineer's interpretation of the subsurface conditions, tests, and the results of analyses conducted. Should the data contained in this report not be adequate for the Contractor's purposes, the Contractor may make, before bidding, independent exploration, tests and analyses. This report may be examined by bidders at the office of the Owner, or copies may be obtained from the Owner at nominal charge.

The contract documents should include the boring data provided in Appendix A.

Additional data and reports prepared by others that could have an impact upon the contractor's bid should also be made available to prospective bidders for informational purposes.

LIMITATIONS

We based the analyses and recommendations submitted in this report on the information revealed by our exploration. We attempted to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction.

We prepared this report to aid in the evaluation of this site and to assist in the design of the project. We intend it for use concerning this specific project. We based our recommendations on information on the site and proposed construction as described in this report. Substantial changes in loads, locations or grades should be brought to our attention so we can modify our recommendations, as needed. We would appreciate an opportunity to review the plans and specifications as they pertain to the recommendations contained in this report, and to submit our comments to you based on this review.

We have endeavored to complete the services identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this report, or any other instrument of service.

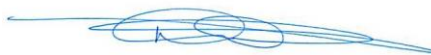
We appreciate the opportunity to be of service for this project. Please call us if you have any questions regarding this report.

Sincerely,

SCHNABEL ENGINEERING CONSULTANTS, INC.



Kristina Haggard
Project Engineer



Bill Khouri, PE
Principal



“Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 17793, Expiration Date: 5-12-2012.”

KH:BK:is

G:\2011\11612077\WP\FINAL\Mont. College - Science West Bldg. Ren (Final).doc

Figures

- Figure 1: Site Vicinity Map
- Figure 2: NW Addition and SW Addition Building Plan
- Figure 3: East Addition Building Plan
- Figure 4: Approximate Test Boring and Test Pit Location Plan
- Figure 5: Lateral Earth Pressures on Below-Grade Walls

Appendices

- Appendix A: Recent Subsurface Exploration Data
- Appendix B: Soil Laboratory Test Data
- Appendix C: Hand Auger Logs and Test Pit Cross Sections

FIGURES

Figure 1: Site Vicinity Map

Figure 2: NW Addition and SW Addition Building Plan

Figure 3: East Addition Building Plan,

Figure 4: Approximate Test Boring and Test Pit Location Plan

Figure 5: Lateral Earth Pressures on Below-Grade Walls



Source: ESRI Online Premium Services (©2011 BING)
Projection: WGS 1984 Web Mercator Auxiliary Sphere

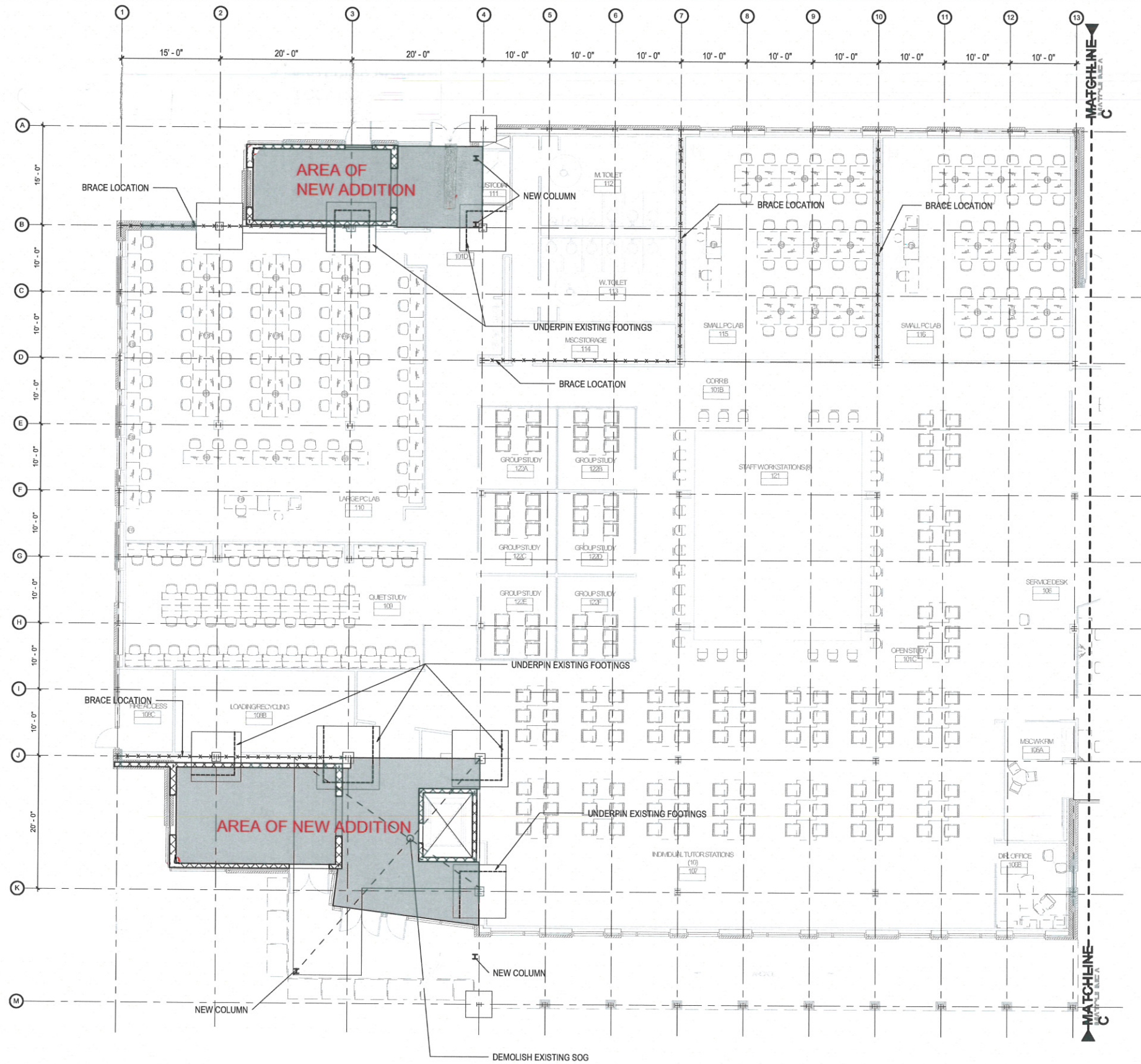


SCIENCE WEST BUILDING
MONTGOMERY COLLEGE
MANNAKEE STREET, ROCKVILLE, MD

11612077

SITE VICINITY MAP

FIGURE 1

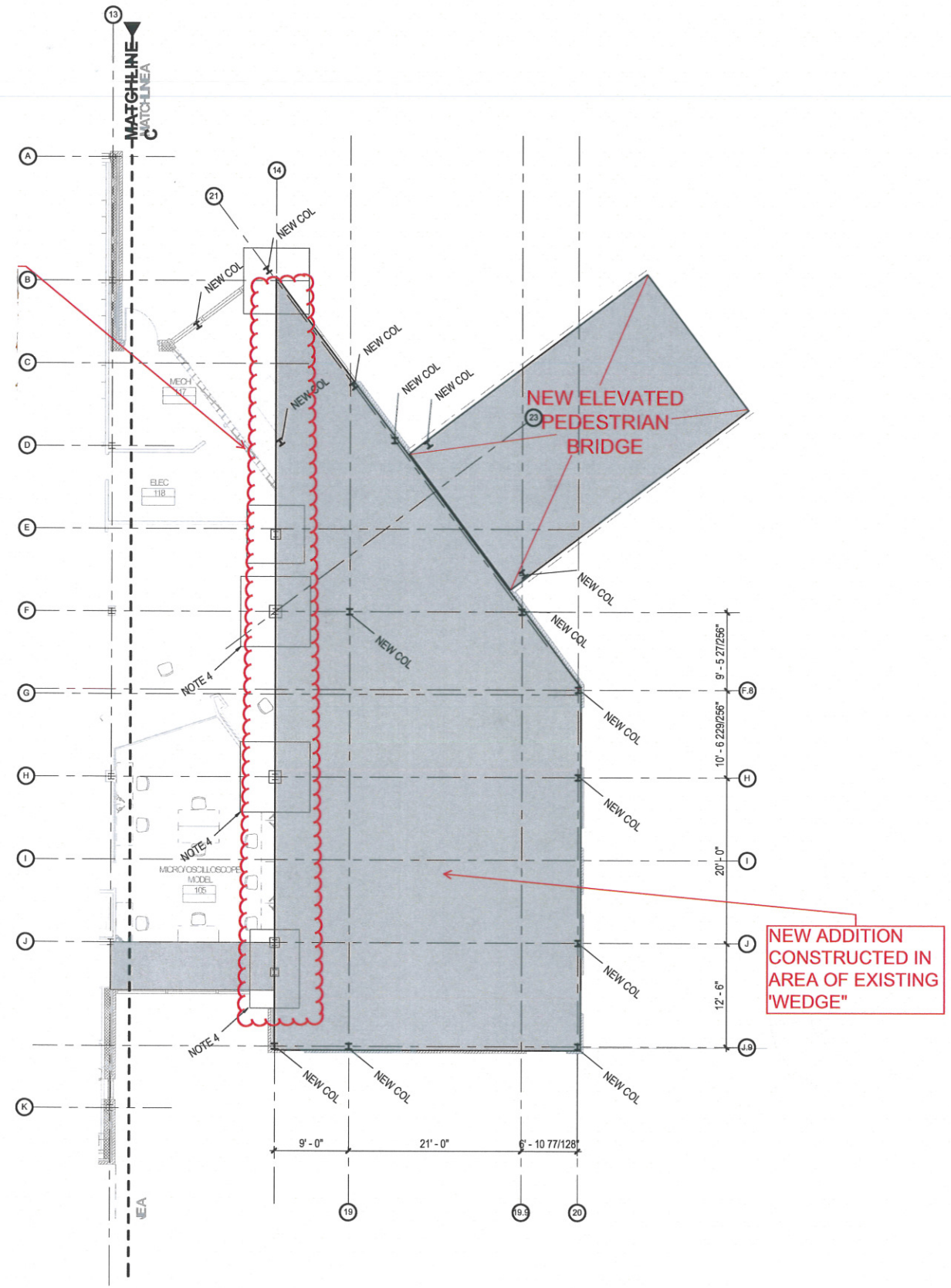


SCIENCE WEST BUILDING ADDITIONS
MONTGOMERY COLLEGE
ROCKVILLE, MARYLAND

Drawn by:
K. HAGGARD
Reviewed by:
B. KHOURI

Approximate Scale:
No Scale
Date:
DECEMBER 2011

**NW ADDITION & SW ADDITION
BUILDING PLAN**
PROJECT NO. 11612077
FIGURE 2

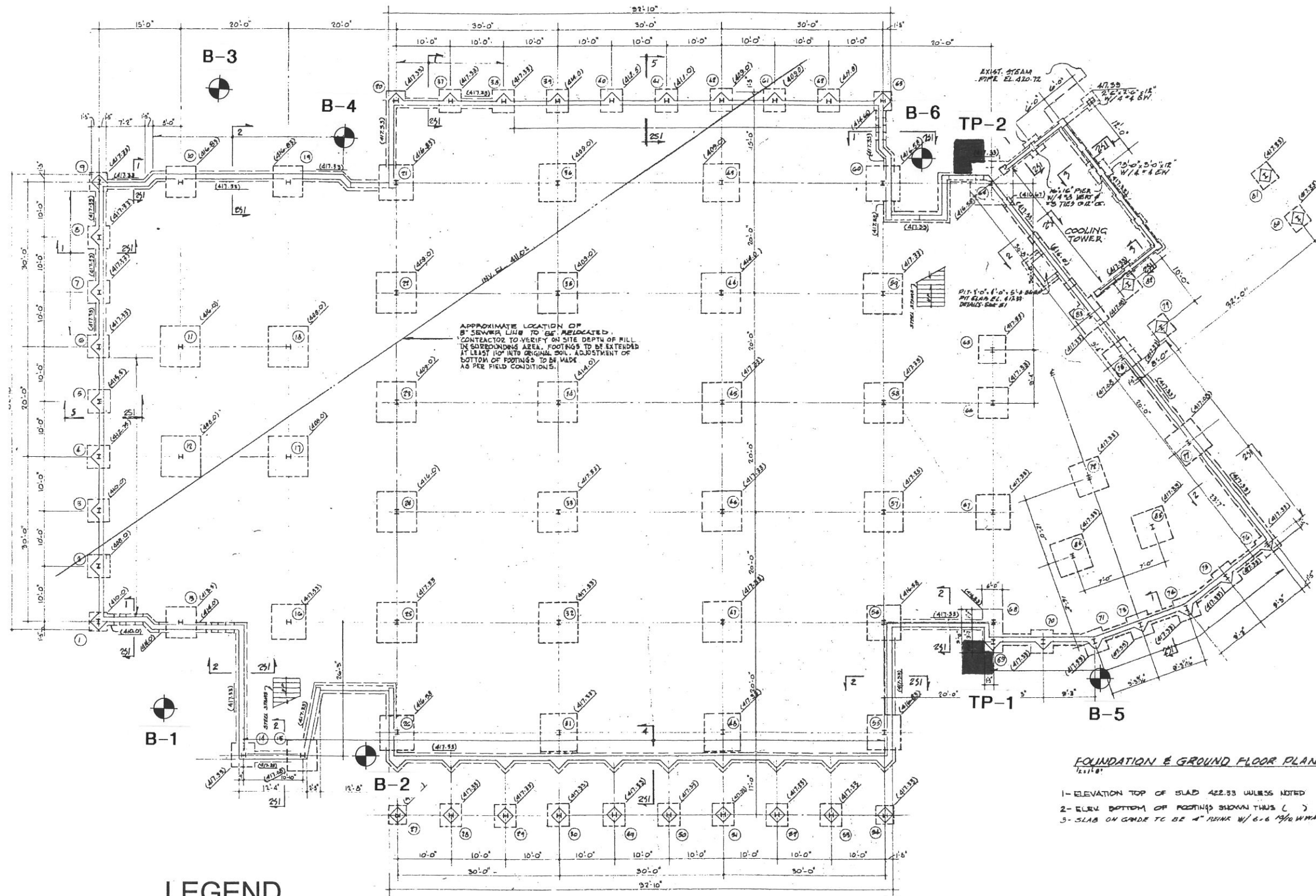


SCIENCE WEST BUILDING ADDITIONS
MONTGOMERY COLLEGE
ROCKVILLE, MARYLAND

Drawn by:
K. HAGGARD
Reviewed by:
B. KHOURI

Approximate Scale:
No Scale
Date:
DECEMBER 2011



EAST ADDITION BUILDING PLAN
PROJECT NO. 11612077
FIGURE 3




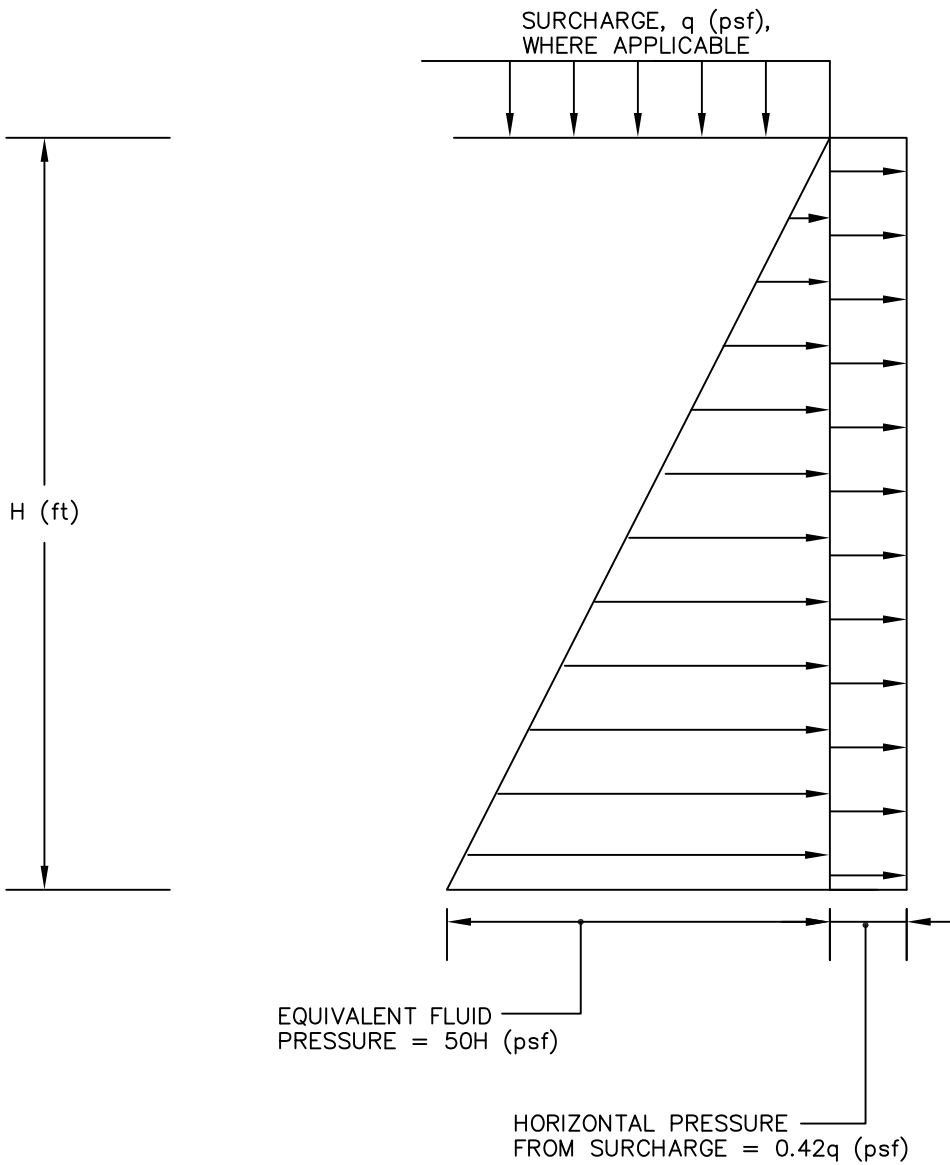
FOUNDATION & GROUND FLOOR PLAN
1:11'0"

- 1- ELEVATION TOP OF SLAB 422.33 UNLESS NOTED
- 2- ELEV. BOTTOM OF FOOTINGS SHOWN THUS ()
- 3- SLAB ON GRADE TO BE 4" REIN. W/ 6-6 #4 @ 10" MAX.

LEGEND

-  APPROXIMATE BORING LOCATION
-  APPROXIMATE TEST PIT LOCATION

	SCIENCE WEST BUILDING ADDITIONS MONTGOMERY COLLEGE ROCKVILLE, MARYLAND		Drawn by: K. HAGGARD	Approximate Scale: No Scale	APPROXIMATE BORING & TEST PIT LOCATION PLAN
			Reviewed by: B. KHOURI	Date: DECEMBER 2011	PROJECT NO. 11612077 FIGURE 4



- NOTES:
- 1) Earth Pressure Diagram shown assumes full drainage of hydrostatic pressure.
 - 2) See report text for backfill material requirements.

SCIENCE WEST BUILDING ADDITIONS MONTGOMERY COLLEGE ROCKVILLE, MARYLAND	LATERAL EARTH PRESSURE DIAGRAM FOR DESIGN OF BELOW-GRADE WALLS PROJECT NO. 11612077 FIGURE 5	DRAWN BY: K. HAGGARD REVIEWED BY: B. KHOURI	APPROXIMATE SCALE: NOT TO SCALE DATE: DECEMBER 2011
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APPENDIX A

RECENT SUBSURFACE EXPLORATION DATA

Subsurface Investigation Procedures (1 sheet)
Test Boring Log General Notes (1 sheet)
Identification of Soils (1 sheet)
Boring Logs, B-1 through B-6 (12 sheets)

SUBSURFACE INVESTIGATION PROCEDURES

1. Test Borings - Hollow Stem Augers

The borings are advanced by turning an auger with a center opening of 2 ¼ inches or 3 ¼ inches. A plug device blocks off the center opening while augers are advanced. Cuttings are brought to the surface by the auger flights. Sampling is performed through the center opening in the hollow stem auger, by standard methods, after removal of the plug. Usually, no water is introduced into the boring using this procedure.

2. Standard Penetration Tests

Numbers after description of the soil strata indicate the minimum and maximum penetration resistance, or N value, recorded in each stratum. The N values indicate the penetration resistance in blows per foot of a standard 2-inch O.D., 1 ⅝-inch I.D. sampling spoon driven with a 140-pound hammer falling 30 inches per ASTM D-1586. After an initial set of 6 inches to assure the sampling spoon is in undisturbed material, the number of blows required to drive the sample an additional 12 inches is generally taken as the N value. In the event that 30 or more blows are required on the initial 6-inch interval, the sampling spoon is driven to a total penetration resistance of 100 blows or 18 inches, whichever occurs first.

3. Test Pit

Personnel from our office hand-dug the test pit to the bottom of the footing. Following the excavation, a Senior Staff Engineer from our office observed the test pit and visually classified the soils encountered according to ASTM D-2488. We also performed DCP testing to a depth of about 5 ft below the bottom of the exposed footings. The stratification lines shown in the test pit drawings represent the approximate boundary between soil types as observed in the test pits. The soil profiles have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location. Following our observation, the test pits were backfilled with minimal compaction. Excess soils were removed from the site.

4. Dynamic Cone Penetrometer Test Results



Numbers included on the logs indicate the number of blows required to drive a light Dynamic Cone Penetrometer 1 ¾ inches into the soil using a 15-pound hammer at a falling distance of 20 inches.

5. Boring and Test Pit Locations and Grades

We approximately staked the borings and test pit in the field. Elevations were estimated from topographic plans provided by your office. Approximate test locations are shown on Figure 4.

TEST BORING LOG GENERAL NOTES

1. Numbers in the sampling data column indicate the number of blows required to drive a 2-inch O.D., 1-3/8 inch I.D. split spoon sampler through three 6-inch intervals, or as indicated, using a 140-pound hammer falling 30 inches, according to ASTM D-1586. The sum of the second and third 6-inch blow count intervals is the N value of the Standard Penetration Test (SPT).
2. Strata descriptions are based on visual inspection and are in accordance with the Unified Soil Classification System, ASTM D-2488.
3. Refusal at the surface of rock, boulder, or obstruction is defined as a penetration resistance of 100 blows for 2 inches penetration or less.
4. Disintegrated rock is defined as residual earth material with a penetration resistance between 60 blows per foot and refusal.
5. Key to abbreviations and symbols:

w %	= Moisture Content	3T	= 3 inch Tube Sample
	= Area Sampled	24/20	= Tube Sample Pushed 24 inches, 20 inches Recovered
	= Rock Coring	REC	= Rock Core Recovery
WOR	= Weight of Rod	RQD	= Rock Quality Designation
WOH	= Weight of Hammer	WOW	= Water Observation Well
6. The boring logs and related information depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions at the boring locations. Also, the passage of time may result in a change in the subsurface soil and groundwater conditions at the boring locations.
7. The stratification lines represent the approximate boundary between soils and/or rock types as estimated in the drilling and sampling operation. Some variation may be expected vertically between samples taken. The soil profile, water level observations, and penetration resistances presented on the boring logs have been made with reasonable care and accuracy, but must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.
8. Estimated groundwater levels are indicated on the logs. These are only estimates from available data and may vary with variations in environmental conditions, precipitation, surface drainage, time of the year, evaporation, adjacent construction, porosity of the soil, site topography and other similar factors.

IDENTIFICATION OF SOIL

I. DEFINITION OF SOIL GROUP NAMES (ASTM D2487)

SYMBOL GROUP NAME

Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels – More than 50% of coarse fraction retained on No. 4 sieve Coarse, ¾” to 3” Fine, No. 4 to ¾”	Clean Gravels Less than 5% fines	GW	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		Gravels with fines More than 12% fines	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	Sands – 50% or more of coarse Fraction passes No. 4 sieve Coarse, No. 10 to No. 4 Medium, No. 40 to No. 10 Fine, No. 200 to No. 40	Clean Sands Less than 5% fines	SW	WELL GRADED SAND
			SP	POORLY GRADED SAND
Sands with fines More than 12% fines		SM	SILTY SAND	
		SC	CLAYEY SAND	
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays – Liquid Limit less than 50 Low to medium plasticity	Inorganic	CL	LEAN CLAY
			ML	SILT
		Organic	OL	ORGANIC CLAY
				ORGANIC SILT
	Silts and Clays – Liquid Limit 50 or more Medium to high plasticity	Inorganic	CH	FAT CLAY
			MH	ELASTIC SILT
Organic		OH	ORGANIC CLAY	
			ORGANIC SILT	
Highly Organic Soils	Primarily organic matter, dark in color and organic odor	PT	PEAT	

II. DEFINITION OF SOIL COMPONENT PROPORTIONS (ASTM D2487)

Examples

Adjective Form	GRAVELLY SANDY	>30% to <50% coarse grained component in a fine-grained soil	GRAVELLY LEAN CLAY
	CLAYEY SILTY	>12% to <50% fine grained component in a coarse-grained soil	SILTY SAND
“With”	WITH GRAVEL WITH SAND	>15% to <30% coarse grained component in a fine-grained soil	FAT CLAY WITH GRAVEL
	WITH GRAVEL WITH SAND	>15% to <50% coarse grained component in a coarse-grained soil	POORLY GRADED GRAVEL WITH SAND
	WITH SILT WITH CLAY	>5% to <12% fine grained component in a coarse-grained soil	POORLY GRADED SAND WITH SILT

III. GLOSSARY OF MISCELLANEOUS TERMS

SYMBOLS	Unified Soil Classification Symbols are shown above as group symbols. A dual symbol “-“ indicates the soil belongs to two groups. A borderline symbol “/” indicates the soil belongs to two possible groups.
FILL	Man-made deposit containing soil, rock and often foreign matter.
PROBABLE FILL	Soils which contain no visually detected foreign matter but which are suspect with regard to origin.
DISINTEGRATED ROCK (DR)	Residual materials with a standard penetration resistance (SPT) between 60 blows per foot and refusal. Refusal is defined as a SPT of 100 blows for 2” or less penetration.
PARTIALLY WEATHERED ROCK (PWR)	Residual materials with a standard penetration resistance (SPT) between 100 blows per foot and refusal. Refusal is defined as a SPT of 100 blows for 2” or less penetration.
BOULDERS & COBBLES	Boulders are considered rounded pieces of rock larger than 12 inches, while cobbles range from 3 to 12 inch size.
LENSES	0 to ½ inch seam within a material in a test pit.
LAYERS	½ to 12 inch seam within a material in a test pit.
POCKET	Discontinuous body within a material in a test pit.
MOISTURE CONDITIONS	Wet, moist or dry to indicate visual appearance of specimen.
COLOR	Overall color, with modifiers such as light to dark or variation in coloration.



Project: Science West Building Additions
 Montgomery College
 Rockville, Maryland

Boring Number: B-1
Contract Number: 11612077
Sheet: 1 of 2

Contractor: Recon Drilling
Contractor Foreman: W. Rodas
Schnabel Representative: W. Walker
Equipment: CME 550 (ATV)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 11/19/11 **Finished:** 11/19/11
Location: See Location Plan
Ground Surface Elevation: 421± (ft) **Total Depth:** 35.0 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	11/19	---	23.0'	---	---	
Completion	11/19	---	20.2'	---	---	
Casing Pulled	11/19	---	19.4'	---	30.4'	
After Drilling	11/20	---	16.6'	---	26.7'	

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
0.2	Topsoil	FILL	420.8	A		SS 2+3+5 REC=15", 83%		
	PROBABLE FILL, sampled as sandy silt; moist, reddish brown, estimated <5% mica, roots							
2.5	SANDY SILT; moist, dark brown, estimated <5% mica	ML	418.5	B		SS 3+5+9 REC=10", 56%		
	Change: yellowish brown				5	SS 6+10+14 REC=18", 100%		
					10	SS 14+22+27 REC=18", 100%		
					15	SS 17+23+31 REC=18", 100%		
					20	SS 10+15+20 REC=18", 100%		
							SS 5+12+14 REC=18", 100%	

TEST BORING LOG 11612077 LOGS_11-22.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 1/28/12

(continued)



Schnabel TEST BORING LOG
ENGINEERING

Project: Science West Building Additions
Montgomery College
Rockville, Maryland

Boring Number: **B-1**
Contract Number: 11612077
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
	Change: light brown	ML	386.0	B	30	SS 11+16+21 REC=18", 100%		
					35	SS 6+12+17 REC=18", 100%		
35.0	Bottom of Boring at 35.0 ft.							



Project: Science West Building Additions
 Montgomery College
 Rockville, Maryland

Boring Number: B-2
Contract Number: 11612077
Sheet: 1 of 2

Contractor: Recon Drilling
Contractor Foreman: W. Rodas
Schnabel Representative: W. Walker
Equipment: CME 550 (ATV)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 11/20/11 **Finished:** 11/20/11
Location: See Location Plan
Ground Surface Elevation: 420± (ft) **Total Depth:** 45.0 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	11/20	---	18.5'	---	---	
Completion	11/20	---	22.8'	---	---	
Casing Pulled	11/20	---	17.6'	---	37.9'	

TEST BORING LOG 11612077 LOGS-11-22.GPJ SCHNABEL DATA TEMPLATE 2008-07-06.GDT 1/28/12

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.3	Concrete		419.7					
0.5	GRAVEL		419.5					
	FILL, sampled as clayey sand; moist, dark brown and reddish brown, estimated <5% mica, contains rock fragments	FILL		A		SS 1+2+4 REC=18", 100%		
3.5	ELASTIC SILT WITH SAND; moist, orangish brown and reddish brown, estimated <5% mica	MH	416.5		5	SS 5+3+5 REC=18", 100%	MC = 24.3%	
				C		SS 2+2+3 REC=18", 100%	LL = 57 PL = 45 MC = 37.3%	
8.5	SANDY SILT; moist, brown with mottles of black, estimated <5% mica, and light brown		411.5		10	SS 5+5+5 REC=18", 100%	MC = 20.8%	
					15	SS 7+11+11 REC=18", 100%	MC = 20.0%	
				B				
	Change: orangish brown				20	SS 11+9+12 REC=18", 100%		
	Change: olive brown with mottles of black, and light brown					SS 13+16+22 REC=18", 100%		

(continued)



Schnabel TEST BORING LOG
ENGINEERING

Project: Science West Building Additions
Montgomery College
Rockville, Maryland

Boring Number: **B-2**
Contract Number: 11612077
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
	Change: olive brown							
					30	SS 11+13+20 REC=18", 100%		
				B	35	SS 6+8+11 REC=18", 100%		
					40	SS 8+13+16 REC=18", 100%		
43.5	DISINTEGRATED ROCK, sampled as silt; brown with streaks of black, and light gray, contains est <5% mica	DR	376.5	D		SS 27+66+80 REC=18", 100%		
45.0			375.0		45			

Bottom of Boring at 45.0 ft.

TEST BORING LOG 11612077 LOGS_11-22.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 1/26/12



Project: Science West Building Additions
 Montgomery College
 Rockville, Maryland

Boring Number: B-3
Contract Number: 11612077
Sheet: 1 of 2

Contractor: Recon Drilling
Contractor Foreman: W. Rodas
Schnabel Representative: W. Walker
Equipment: CME 550 (ATV)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 11/20/11 **Finished:** 11/20/11
Location: See Location Plan
Ground Surface Elevation: 420± (ft) **Total Depth:** 45.0 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	11/19	---	18.0'	---	---	
Completion	11/19	---	18.0'	---	---	
Casing Pulled	11/19	---	18.0'	---	39.1'	
After Drilling	11/20	---	17.5'	---	36.7'	

TEST BORING LOG 11612077 LOGS_11-22.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 1/28/12

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
0.1	Topsoil		419.9					
	FILL, sampled as sandy silt; moist, yellowish red and light brown, contains roots, estimated <5% mica	FILL		A		SS 3+3+4 REC=18", 100%		
2.5	SANDY SILT; moist, brown, estimated 5 - 10% quartz fragments		417.5			SS 5+7+6 REC=18", 100%		
					5	SS 3+5+6 REC=14", 78%		
	Change: yellowish brown, estimated <5% mica, no quartz fragments	ML		B		SS 5+7+9 REC=18", 100%		
					10			
						SS 4+6+9 REC=18", 100%		
					15			
18.5	DISINTEGRATED ROCK, sampled as sandy silt; moist, dark brown with streaks of black, estimated <5% mica	DR	401.5	D		SS 13+23+40 REC=18", 100%		
					20			
23.5	SANDY SILT; moist, dark brown, estimated <5% mica	ML	396.5	B		SS 17+25+25 REC=18", 100%		

(continued)



Project: Science West Building Additions
 Montgomery College
 Rockville, Maryland

Boring Number: B-4
Contract Number: 11612077
Sheet: 1 of 2

Contractor: Recon Drilling
Contractor Foreman: W. Rodas
Schnabel Representative: W. Walker
Equipment: CME 550 (ATV)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 11/19/11 **Finished:** 11/19/11
Location: See Location Plan
Ground Surface Elevation: 421± (ft) **Total Depth:** 35.0 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	11/19	---	18.0'	---	---	
Completion	11/19	---	25.0'	---	---	
Casing Pulled	11/19	---	17.3'	---	29.0'	
After Drilling	11/20	---	17.0'	---	27.5'	

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
2.5	FILL, sampled as sandy silt; moist, reddish brown, contains roots	FILL	418.5	A	2+3+4	SS REC=18", 100%		
	PROBABLE FILL, sampled as sandy silt; moist, reddish brown, contains gravel	FILL			4+4+6	SS REC=5", 28%		
5.0	SILT WITH SAND; moist, reddish brown with streaks of black	ML	416.0	B	5	SS 4+7+9 REC=12", 67%	LL = 44 PL = 40 MC = 21.2%	
			10		SS 9+15+16 REC=18", 100%	MC = 21.7%		
			15		SS 5+9+11 REC=18", 100%	MC = 32.0%		
			20		SS 4+5+7 REC=18", 100%	MC = 42.5%		
					SS 3+7+14 REC=18", 100%			

TEST BORING LOG 11612077 LOGS - 11-22.GPJ - SCHNABEL DATA TEMPLATE 2008_07_06.GDT 1/28/12

(continued)



Schnabel TEST BORING LOG
ENGINEERING

Project: Science West Building Additions
Montgomery College
Rockville, Maryland

Boring Number: **B-4**
Contract Number: 11612077
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
		ML	386.0	B	30	SS 14+18+17 REC=18", 100%		
					35	SS 11+20+28 REC=18", 100%		
35.0	Bottom of Boring at 35.0 ft.							



Project: Science West Building Additions
 Montgomery College
 Rockville, Maryland

Boring Number: B-5
Contract Number: 11612077
Sheet: 1 of 2

Contractor: Recon Drilling
Contractor Foreman: W. Rodas
Schnabel Representative: W. Walker
Equipment: CME 550 (ATV)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 11/20/11 **Finished:** 11/20/11
Location: See Location Plan
Ground Surface Elevation: 420± (ft) **Total Depth:** 35.0 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	11/20	---	15.0'	---	---	
Completion	11/20	---	11.3'	---	---	
Casing Pulled	11/20	---	11.7'	---	30.0'	
After Drilling	11/20	---	11.0'	---	29.4'	

TEST BORING LOG 11612077 LOGS - 11-22-GPJ - SCHNABEL DATA TEMPLATE 2008_07_06.GDT 1/28/12

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
0.1	Topsoil FILL, sampled as sandy silt; moist, reddish brown, estimated <5% mica, gravel, and roots Change: light, brown	FILL	419.9	A		SS 4+8+13 REC=14", 78%		
					5	SS 8+13+16 REC=14", 78%		
						SS 13+22+21 REC=18", 100%		
8.5	WELL GRADED SAND WITH GRAVEL; moist, brown	SW	411.5	B		SS 22+12+6 REC=3", 17%		
					10			
13.5	SANDY SILT; moist, brown with streaks of dark brown, estimated <5% mica	ML	406.5	D		SS 8+22+31 REC=18", 100%		
					15			
18.5	DISINTEGRATED ROCK, sampled as sandy silt; moist, brown with streaks of light brown, estimated <5% mica Change: with streaks of light gray	DR	401.5			SS 100/6" REC=5", 83%		
					20	SS 75+25/1" REC=7", 100%		

(continued)

APPENDIX B

SOIL LABORATORY TEST DATA

Summary of Soil Laboratory Tests (2 sheets)

Gradation Curves (2 sheets)

Summary Of Laboratory Tests

Appendix
Sheet 1 of 2
Project Number: 11612077.00

Boring No.	Sample Depth ft	Sample Type	Description of Soil Specimen	Natural Moisture (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	% Passing No. 40 Sieve	% Passing No. 10 Sieve	% Retained No. 4 Sieve
	Elevation ft										
B-2	3.5 - 5.0	Jar		24.3	--	--	--	--	--	--	--
B-2	6.0 - 7.5	Jar	ELASTIC SILT WITH SAND (MH), reddish brown	37.3	57	45	12	82.6	98.6	100.0	0.0
B-2	8.5 - 10.0	Jar		20.8	--	--	--	--	--	--	--
B-2	13.5 - 15.0	Jar		20.0	--	--	--	--	--	--	--
B-4	5.0 - 6.5	Jar	SILT WITH SAND (ML), orangish brown	21.2	44	40	4	74.7	96.3	100.0	0.0
B-4	8.5 - 10.0	Jar		21.7	--	--	--	--	--	--	--
B-4	13.5 - 15.0	Jar		32.0	--	--	--	--	--	--	--

- Notes:
1. Soil tests in general accordance with ASTM standards.
 2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
 3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed



Project: Montgomery College - Science West Building

DYNAMIC LAB SUMMARY MONT. COLLEGE LAB TEST RESULTS.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 12/21/11

Summary Of Laboratory Tests

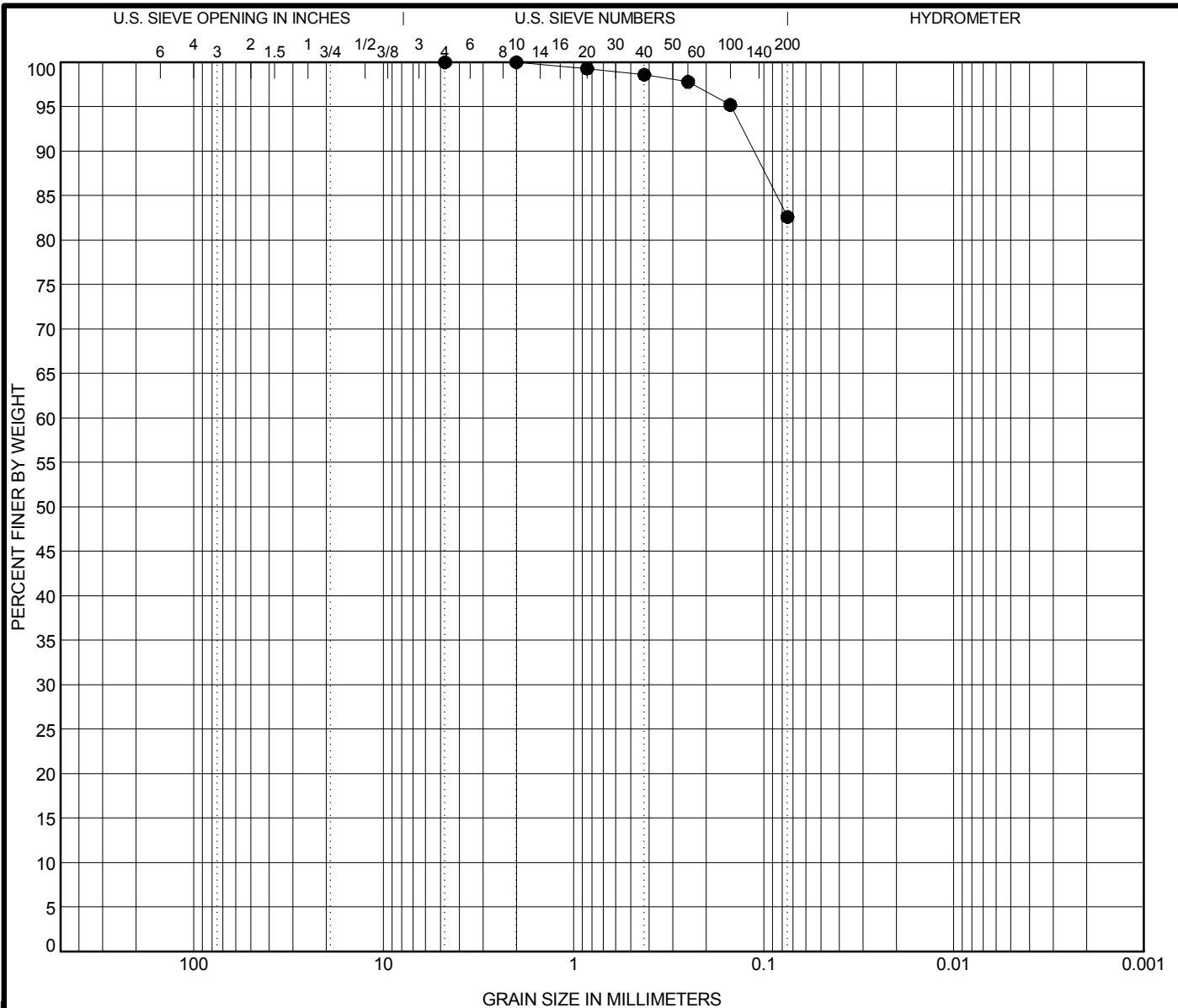
Boring No.	Sample Depth ft	Sample Type	Description of Soil Specimen	Natural Moisture (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	% Passing No. 40 Sieve	% Passing No. 10 Sieve	% Retained No. 4 Sieve
	Elevation ft										
B-4	18.5 - 20.0	Jar		42.4	--	--	--	--	--	--	--
B-6	8.5 - 10.0	Jar		24.9	--	--	--	--	--	--	--
B-6	13.5 - 15.0	Jar		22.6	--	--	--	--	--	--	--

- Notes:
1. Soil tests in general accordance with ASTM standards.
 2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
 3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed



Project: Montgomery College - Science West Building

SIEVE 1/SHEET MONT. COLLEGE LAB TEST RESULTS.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 12/21/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen	Sample Description					LL	PL	PI			
B-2	6.0 ft	ELASTIC SILT WITH SAND (MH), reddish brown					57	45	12		
Test Method		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
ASTM D422		4.75				0.0	17.4	82.6			

Percent Finer							
Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4
% Finer	82.6	95.2	97.8	98.6	99.3	100.0	100.0

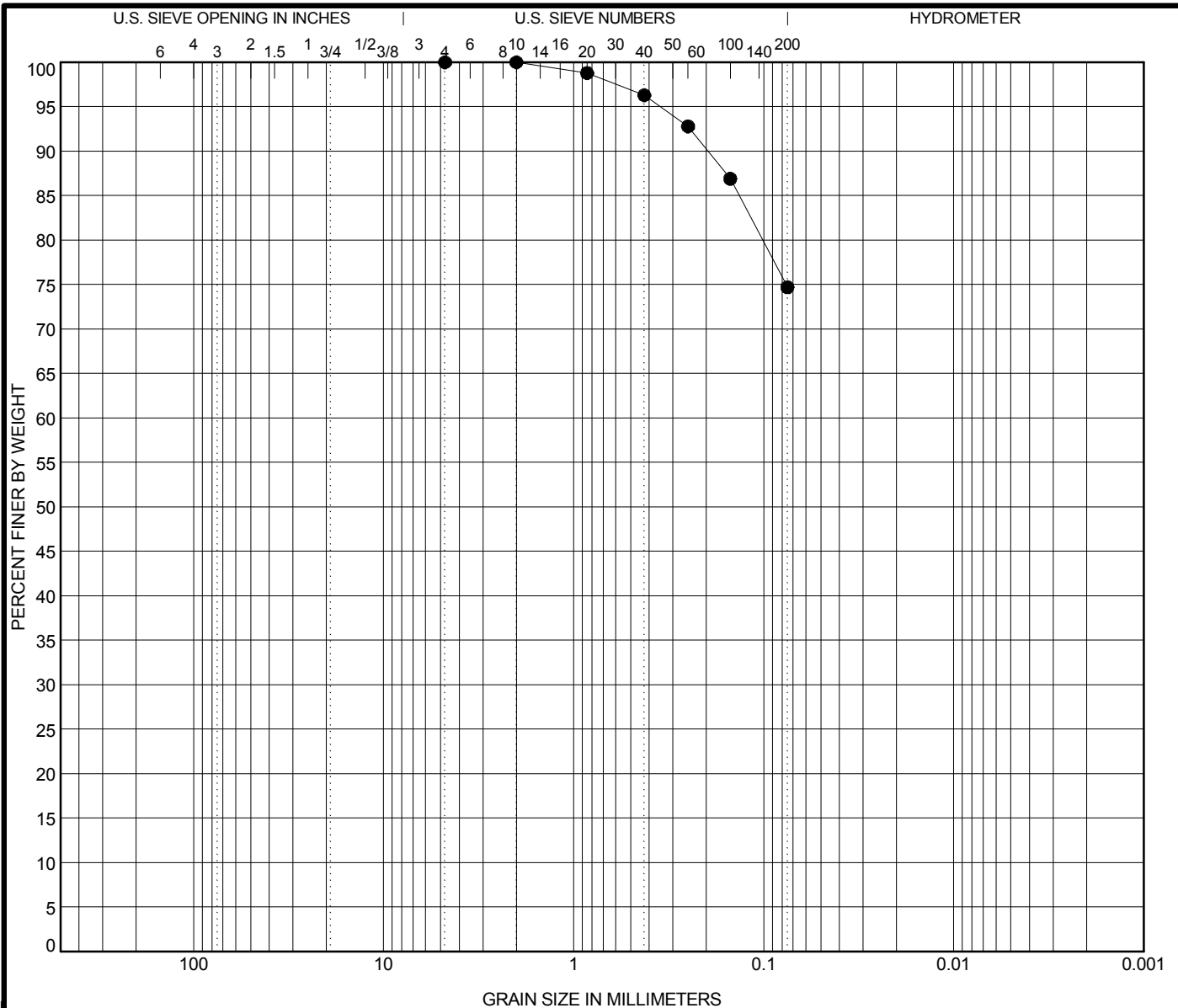


GRADATION CURVE

Project: Montgomery College - Science West Building

Contract: 11612077.00

SIEVE 1/SHEET MONT. COLLEGE LAB TEST RESULTS.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 12/21/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen	Sample Description	LL	PL	PI				
B-4	5.0 ft SILT WITH SAND (ML), orangish brown	44	40	4				
Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	4.75				0.0	25.3	74.7	

Percent Finer							
Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4
% Finer	74.7	86.9	92.8	96.3	98.8	100.0	100.0



GRADATION CURVE

Project: Montgomery College - Science West Building

Contract: 11612077.00

APPENDIX C

HAND AUGER LOGS & TEST PIT CROSS SECTIONS

Hand Auger Log General Notes (1 sheet)
Hand Auger Logs, TP-1 and TP-2 (2 sheets)
Test Pit Cross Sections (2 sheets)

HAND AUGER LOG GENERAL NOTES

The hand augers are logged by Schnabel personnel to provide a record for geotechnical evaluation, construction inspection or other specialized purposes.

The log itself includes a description of soil materials encountered using visual classification in the field. Boundary lines between various strata are identified where possible and a graphical presentation is included based on the material excavated from the hand auger. Any significant features such as fill conditions, underground structures, groundwater, or water seepage conditions are recorded.

Representative soil samples are recovered from the hand augers, generally from each stratum, for later identification and testing. The locations of these samples are generally not shown on the logs unless laboratory tests performed on samples are referred to in the geotechnical analysis.

The hand auger logs and related information depict subsurface conditions only at the specific location and at the particular time excavated. Soil conditions at other locations may differ from conditions existing at these hand auger locations. Also, the passage of time may result in a change in the subsurface soil and groundwater conditions at these locations.

The stratification lines represent the approximate boundary between soil types as observed in the hand augers. The soil profiles and water level observations presented have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.

Numbers included on the logs indicate the number of blows required to drive a light dynamic cone penetrometer 1-3/4 inches into the soil using a 15-pound hammer at a falling distance of 20 inches.



HAND AUGER LOG

Project: Science West Building Additions
 Montgomery College
 Rockville, Maryland

Hand Auger Number: TP-1
Contract Number: 11612077
Sheet: 1 of 1

Contractor: Not Applicable
Contractor Foreman: Not Applicable
Schnabel Representative: W. Walker
Equipment:
Method: Hand Auger

Dates Started: 11/19/11 **Finished:** 11/19/11
Location: See Location Plan

Ground Surface Elevation: **Total Depth:** 2.2 ft

Groundwater Observations					
Date	Time	Depth	Casing	Caved	

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
2.2	SANDY SILT; moist, orangish brown, estimated <5% roots, mica	ML		B				0.0 ft: DCP: 15-27-19
	Change: reddish brown, estimated 5 - 10% rock fragments							1.0 ft: DCP: 22-32-17
	Change: No sample recovery							2.0 ft: DCP: 13-35-30

Bottom of Hand Auger at 2.2 ft.
 Hand auger initiated at bottom of test pit at bottom level of adjacent footing.
 Hand auger refusal at 2.2 ft.
 Hand auger backfilled with excavated material upon completion.
 DCP: Dynamic Cone Penetrometer
 No groundwater was encountered during hand auger.

TEST BORING LOG 11612077 HAND AUGERS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 1/26/12



Schnabel
ENGINEERING
HAND AUGER LOG

Project: Science West Building Additions
Montgomery College
Rockville, Maryland

Hand Auger Number: TP-2
Contract Number: 11612077
Sheet: 1 of 1

Contractor: Not Applicable
Contractor Foreman: Not Applicable
Schnabel Representative: W. Walker
Equipment:
Method: Hand Auger

Dates Started: 11/19/11 **Finished:** 11/19/11
Location: See Location Plan

Ground Surface Elevation: **Total Depth:** 5.2 ft

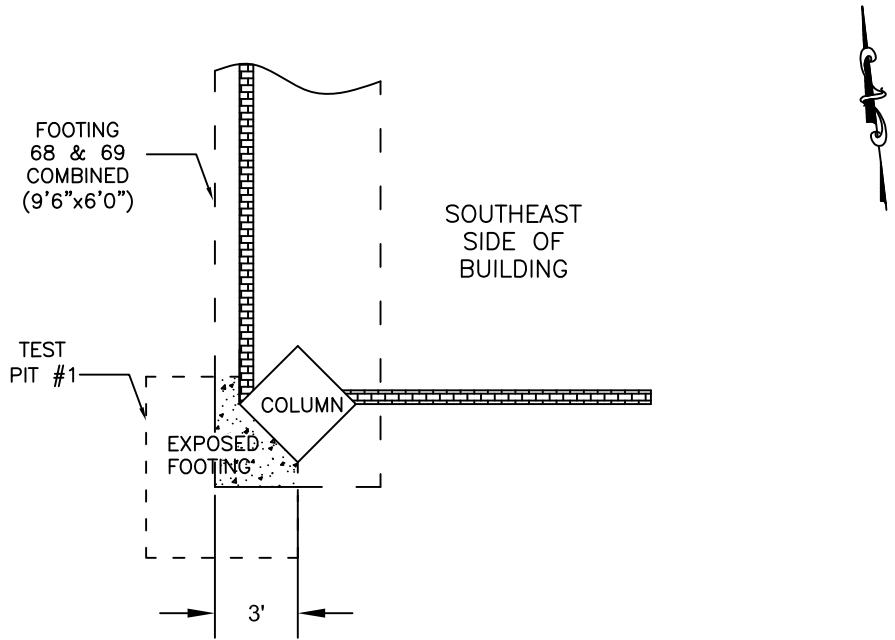
Groundwater Observations					
Date	Time	Depth	Casing	Caved	

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.0	SANDY SILT; moist, reddish brown, estimated <5% mica, estimated 15 - 25% rock fragments	ML		B				0.0 ft: DCP: 9-14-31
1.0	Change: estimated 5 - 10% rock fragments							1.0 ft: DCP: 5-15-14
2.0	Change: light orangish brown to yellowish brown							2.0 ft: DCP: 15-22-28
3.0	Change: olive brown							3.0 ft: DCP: 30-50/1
4.0	SILTY SAND; moist, olive brown, estimated 5 - 10% rock fragments	SM						4.0 ft: DCP: 50/1¼
5.2					5			5.0 ft: DCP: 50/1½

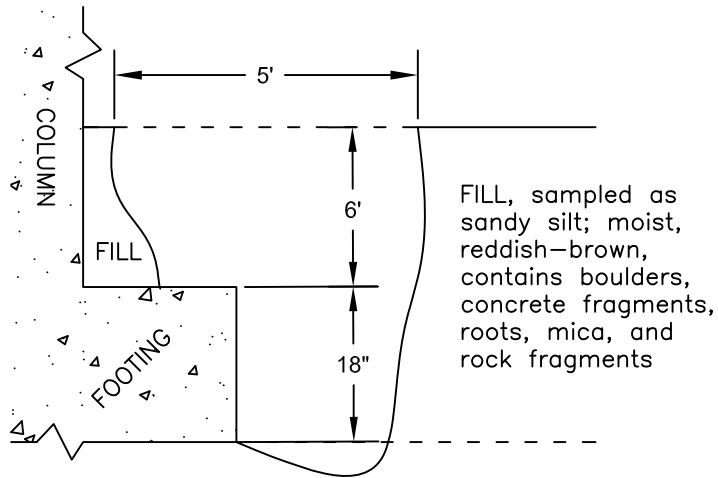
Bottom of Hand Auger at 5.2 ft.
Hand auger initiated at bottom of test pit at bottom level of adjacent footing.
Hand auger backfilled with excavated material upon completion.
DCP: Dynamic Cone Penetrometer
No groundwater was encountered during hand auger.

TEST BORING LOG 11612077 HAND AUGERS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 1/26/12

PLAN VIEW



CROSS-SECTION



SANDY SILT (ML); moist, orangish
brown, estimated <5% mica, and
roots

DRAWN BY: W. Walker

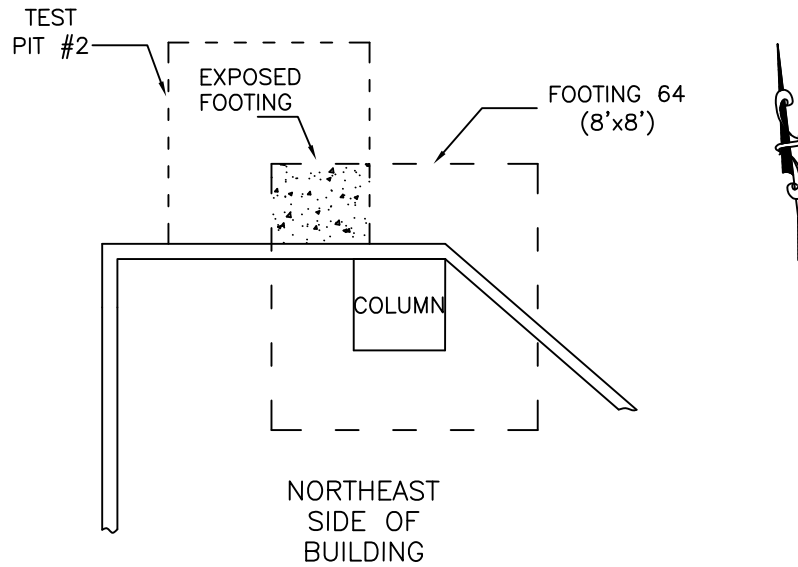


SCIENCE WEST BUILDING ADDITIONS
MONTGOMERY COLLEGE
ROCKVILLE, MARYLAND

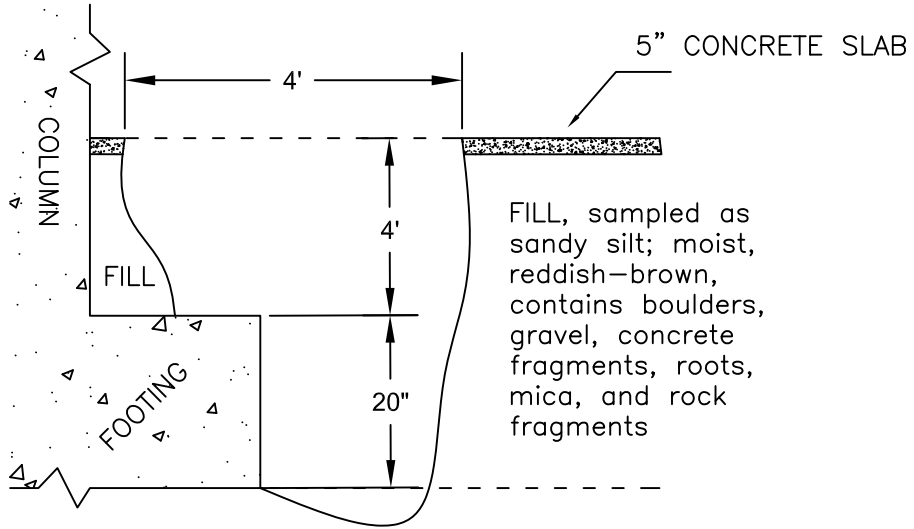
TEST PIT 1 - PLAN & SECTION
(COLUMN 68 & 69)

PROJECT NO.: 11612077
DECEMBER 2011 | FIGURE: TP-1

PLAN VIEW



CROSS-SECTION



SANDY SILT (ML); moist, reddish-brown, estimated <5% mica, estimated 5 to 25% rock fragments

DRAWN BY: W. Walker



SCIENCE WEST BUILDING ADDITIONS
MONTGOMERY COLLEGE
ROCKVILLE, MARYLAND

TEST PIT 2 - PLAN & SECTION
(COLUMN 64)

PROJECT NO.: 11612077
DECEMBER 2011 | FIGURE: TP-2