

CONSTRUCTION DOCUMENTS

SCSD2 - SHS FAMILY CONSUMER SCIENCE RENOVATION



DATE: MARCH 21, 2024

ADG #2023-70



SHERIDAN COUNTY SCHOOL DISTRICT #2

SHS – FAMILY CONSUMER SCIENCE RENOVATION

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INVITATION TO BID

Notice is hereby given that Sheridan County School District #2, 201 North Connor Street, Suite 100, Sheridan, Wyoming will receive sealed bids for the SCSD2 – SHS Family Consumer Science Renovation up to the date and time as stated below.

SCSD2 – SHS FAMILY CONSUMER SCIENCE RENOVATION

BID OPENING: Thursday, April 18th, 2024, at 10:00 A.M.

Location: SCSD#2's Administration Office
201 North Connor Street, Suite 100
Sheridan, WY 82801

MANDATORY Prebid Conference: Tuesday, April 2, 2024, at 3:30 P.M.

Location: Sheridan High School
1056 Long Drive
Sheridan, WY 82801

The Prebid Conference is MANDATORY for all general contractors.

Drawings, Specifications, and Bid Forms are available after March 21, 2024, at: Wyoming School Facilities Division (<http://sfd.wyo.gov/projects-2/project-bid-information>). They will also be posted on www.QuestCDN.com, the project number is 9027800.

Wyoming preference will be according to the School Board Policy. Bidders are required to include a bid bond in the amount of 10% of the base bid, payable to the Sheridan County School District #2 in accordance with the Instructions to Bidders.

The Sheridan County School District #2 reserves the right to accept or reject any or all bids and to waive any irregularities or informalities in the bidding.

Signed: Troy Decker
Facilities Manager

INSTRUCTIONS TO BIDDERS

1. BIDDER REPRESENTATION:

Each bidder by making his bid represents that:

- 1.1 He has read and understands the Bidding Documents and the Contract Documents, and his Bid is made in accordance therewith. By submitting a Bid, the Bidder acknowledges that he has read this solicitation, understands it, and agrees to be bound by its terms and conditions.
- 1.2 He has visited and examined the site, has compared it with the plans and specifications, and has familiarized and satisfied himself with the local conditions under which the work is to be performed, and therefore assumes responsibility for estimating properly the difficulties and cost of successfully performing the Work.
- 1.3 His Bid is based upon the specified results of the remediation described in the Bidding documents without exceptions.
- 1.4 That he is financially solvent and that he is experienced in and competent to perform the type of work as specified.
- 1.5 That he is familiar with all Federal, State and Municipal laws, ordinances and regulations, which may in any way affect the work.
- 1.6 The failure of omission of any Bidder to do any of the foregoing shall in no way relieve the Bidder from any obligation in respect to his Bid Proposal.

2. PREPARATION AND SUBMISSION OF BID PROPOSAL:

- 2.1 Bidders are required to use the Form of Bid enclosed in the Bidding Documents.
- 2.2 The proposal shall not be modified or conditioned in any manner.
- 2.3 All blank spaces must be filled in, in ink or typewritten, and the Bid Proposal must be fully completed and executed when submitted. No alterations in the Bid Proposal or in the printed forms by erasures or deletions will be acceptable unless each alteration is initialed by the Bidder.
- 2.4 All names must be typed or printed below the signature.
- 2.5 The Bid shall contain an acknowledgment of receipt of all Addenda.
- 2.6 All copies of the Bid, the Bid Bond and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope, marked "Bid for SCSD#2 – SHS Family Consumer Science Renovation".
- 2.7 The envelope containing the Bid Proposal should bear on the outside the name of the Bidder, Bidder's address, project name, date and time of Bid opening. If a Bid is submitted by mail or express mail, this aforementioned sealed envelope should be

enclosed in an outer envelope and sent to the following address: The outer envelope shall be marked "Bid Enclosed".

**Sheridan County School District #2
201 N Connor St., Suite 100
Sheridan, WY 82801**

- 2.8 Each copy of the Bid shall include the legal name of Bidder, and shall be signed by the person or persons legally authorized to bind the Bidder to the Contract. A Bid by a corporation shall have the corporate seal affixed. A Bid submitted by agent shall have a current Power of Attorney attached certifying the agent's authority to bind the Bidder.
- 2.9 Bid shall include a **complete list of all proposed subcontractors** and suppliers of major items of material and equipment. All prime bidders must attend the Mandatory Pre-Bid conference as required in Article 4.1.2 of the Instructions to Bidders.
- 2.10 Where so indicated by the makeup of the Form of Bid sums shall be expressed in both words and figures and, in case of discrepancy between the two, the written amount shall govern.
- 2.11 In case of an error in the extension of a price in the Bid, the unit price will govern.
- 2.12 All requested alternates (if any) shall be bid.
- 2.13 Bidders shall make no additional stipulation or voluntary alternates on the Bid Form or in separate envelopes, nor qualify his Bid in any other manner.
- 2.14 Bidder shall assume full responsibility for timely delivery at location designated for receipt of Bids. A Bid is invalid if it has not been deposited at the designated location prior to the time and date for receipt of Bids stated herein or in the Invitation to Bid, or any extension thereof issued to the Bidders.

3. RECEIPT AND OPENING OF BIDS:

- 3.1 Bids will be received by Sheridan County School District No. 2, Sheridan, Wyoming (herein called SCSD#2 or Owner) at the time and place stated in the Advertisement and Invitation for Bids and then publicly opened and read aloud.
- 3.2 All Bids will remain subject to acceptance for forty-five (45) days after the day of the Bid opening, but SCSD#2 may, in its sole discretion, release any Bid and return the Bid security prior to that date.

4. CONSIDERATION AND AWARDDING OF BIDS:

- 4.1 Qualifications of Contractors:
 - 4.1.1 Submission of Qualification Statement: if the Owner desires, the Bidder to whom award of a contract is under consideration shall submit to the Owner, Architect or Engineer, upon his request, a properly executed Contractor's Qualification Statement, AIA Document A305, unless such statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

4.1.2 **Mandatory Pre-Bid Conference Attendance:** Prime Bidders are required to attend the Pre-Bid conference at the time and date indicated in the Invitation to Bid.

4.2 Qualifications of Subcontractors:

4.2.1 The Bidder may be required to establish to the satisfaction of the Owner the reliability and responsibility of the proposed Subcontractors to furnish and perform the work described in the Sections of the Specifications pertaining to such proposed Subcontractors' respective trades.

4.2.2 If the Owner or Architect has objection to any person or organization on such list, and refuses in writing to accept such person or organization, The Bidder may, at his option, (a) withdraw his Bid, or (b) submit an acceptable Subcontractor.

4.3 Awarding of the Bid:

4.3.1 SCSD#2 shall have the right to reject any or all Bids, for any reason. Specifically, but without limitation, SCSD#2 shall have the right to reject a Bid not accompanied by Bid security in the proper form and amount, or a Bid not accompanied by data required by the Bidding Documents, or a Bid which is in any way incomplete, irregular, or unresponsive.

4.3.2 The Owner may make such investigations as he deems necessary to determine the ability of the Bidder to perform the Work, and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid, if the evidence submitted by, or the investigation of, such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein.

4.3.3 In awarding the contract, the Owner reserves the right to consider, in addition to the amount of the Bid, the competency, responsibility, and suitability of the Bidder. Contracts, therefore, will not necessarily be awarded to the low bidder(s). The Owner further reserves the right to accept or reject alternates in any order or combination, to accept or reject any bid on any section or all sections of the Specifications, to waive any irregularities or informalities in any bid received; and to award contracts in the best interest of the Owner.

5. **MODIFICATION AND WITHDRAWAL OF BID PROPOSAL:**

5.1 Any Bid Proposal may be withdrawn prior to the scheduled time for the opening of Bids.

5.2 Any Bid Proposal can be modified by telegraphic communication, providing such communication is received by the SCSD#2 prior to the actual time of the Bid opening. The changes to the Bid must be in writing and submitted in a sealed envelope.

5.3 A Bid may not be modified, withdrawn or canceled by the Bidder for a period of forty-five (45) days following the time and date designated for the receipt of Bids, and Bidder so agrees in submitting the Bid.

6. ADDENDA INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS:

- 6.1 Each Bidder shall examine the Bidding Documents carefully and no later than eight (8) days prior to the date of receipt of Bids shall make written or verbal request to the Architect:

Arete Design Group
228 East Brundage Street, Suite 100
Sheridan, WY 82801
Phone: 307-672-8270

for interpretation or correction of ambiguity, inconsistency or error therein which he may discover. Any interpretation or correction will be issued as an Addendum by the Architect. Only a written interpretation or correction by Addendum will be binding. No Bidder shall rely upon interpretation or correction given by any other methods.

- 6.2 Prior to receipt of Bids, any Addenda will be mailed or delivered to each person or firm recorded by the SCSD#2 as having received the Bidding Documents and will be available for inspection at the aforementioned office.
- 6.3 Bidders shall acknowledge receipt of all Addenda which have been issued during the period of Bidding and agree that said Addenda shall become part of this contract. Bidder shall list the numbers and issuing dates of Addenda received.
- 6.4 No Addenda will be issued later than three (3) days prior to the date for receipt of bids except an Addendum withdrawing the request for Bids or one which includes postponement for the date for receipt of Bids. Addenda are considered issued when posted.
- 6.5 Sheridan County School District's representative for this project is stated below. Please direct any questions to:
- Mr. Troy Decker, Facilities Director
Sheridan County School District No. 2
Phone 307-674-7405

7. BID SECURITY:

- 7.1 Each Bid must be accompanied by a Bid Bond payable to Sheridan County School District No. 2 for ten percent (10%) of the total amount of the Base Bid, (a certified check may be used in lieu of a Bid Bond) pledging that the Bidder will enter into a contract with SCSD#2 on the terms stated in his Bid.
- 7.2 SCSD#2 will have the right to retain the bid security of Bidder until a) the Contract has been executed and bonds, as required, have been furnished or (b) the specified time has elapsed so the Bids may be withdrawn, or (c) all Bids have been rejected.
- 7.3 Should the Bidder refuse to enter into such a Contract or fail to furnish the required bonds, the amount of the bid security shall be forfeited to SCSD#2 as liquidated damages, and not as a penalty.

- 7.4 The Bid Security of other Bidders will be retained for a period of thirty (30) days after the Bid opening.
- 7.5 The Bid Security must clearly make reference to the Bid.
- 7.6 The Bid Bond shall be signed or countersigned by a Wyoming resident agent licensed to conduct business in the State of Wyoming.

8. CONTRACT SECURITY:

- 8.1 If the contract price is in excess of \$7,500 a Performance and Payment Bond is required. The Bond shall be in the amount of one hundred percent (100%) of the contract price, with a corporate surety approved by SCSD#2, and will be required for the faithful performance of the contract, prior to contract execution.
- 8.2 A "Letter of Credit", acceptable to the Owner, may be submitted in-lieu of the required Performance and Payment Bond. The Letter of Credit shall indicate the credit amount, what is covered and the conditions under which the Owner may require payment. The Letter of Credit shall also reference the statutory requirements of Wyoming State Statutes 16-6.112 and 16-6.113.
- 8.3 Performance and Payment Bond shall be furnished within ten (10) calendar days of Notice of Award of the Contract.
- 8.4 Performance and Payment Bond shall be signed or countersigned by a Wyoming resident agent licensed to conduct business in the State of Wyoming.
- 8.5 If, at any time, SCSD#2 be or become dissatisfied with any surety or sureties, then upon the Performance Bond, or if for any other reason, each Bond shall cease to be adequate security to SCSD#2, the Contractor shall within five (5) days after notice from SCSD#2, substitute an acceptable bond.

9. POWER OF ATTORNEY:

- 9.1 Attorneys-in-fact who execute the bond on behalf of the surety shall affix a certified and current copy of his Power of Attorney.

10. CONTRACT DOCUMENTS:

- 10.1 The Contract Documents consist of the Bid Documents, which include the Advertisement for Bids, Information for Bidders, Special Conditions, General Conditions, Addendum, Bid Bond, Bid Proposal, Bid Schedule, Specifications and Project Drawings.

11. NOTICE OF AWARD AND FAILURE TO ENTER INTO CONTRACT:

- 11.1 A Notice of Award will be issued to the successful contractor.
- 11.2 The party to whom the contract is to be awarded will be required to execute the Contract Agreement in triplicate, obtain Certificates of Insurance and a Performance and Payment Bond, as contract security, within ten (10) calendar days from the date the Notice of Award is delivered to the Bidder.

- 11.3 In case of failure of the Bidder to execute the Contract Agreement and provide satisfactory Insurance and Contract Security, SCSD#2 may at their option consider the Bidder in default, in which the Bid Bond accompanying the Proposal shall become the property of the SCSD#2.
- 11.4 If the Bidder to whom the Contract shall have been awarded fails, refuses or neglects to return the Contract, bonds and insurance certificate, SCSD#2 reserves the right to retain the Bid Bond as liquidated damages or take such action as it deems appropriate including legal action for damages or specific performance.

12. NOTICE TO PROCEED:

- 12.1 SCSD#2 will issue a Notice to Proceed when all paperwork is completed and approved. The Contractor shall not begin work until the Notice to Proceed is issued.

13. QUALIFICATIONS OF BIDDERS:

- 13.1 SCSD#2 may make such investigation as it deems necessary to determine the ability of the Bidder to perform the work and the Bidder shall furnish to SCSD#2 all such information and data for this purpose as SCSD#2 may request.
- 13.2 SCSD#2 reserves the right to accept or reject any or all Bids; and reserves the right to let the Bid in any manner it sees fit. SCSD#2 will not be bound to accepting the low Bid, but rather the Bid they feel will be in their best interest.

14. PREFERENCE FOR STATE LABOR AND MATERIALS:

- 14.1 Bidders are advised that the resident contractor preference and State of Wyoming materials preference statutes contained in Wyoming State Statutes Sections 16-6-101 through 16-6-107 and related statutes and rules apply to the submitted bids to the extent required by law.
- 14.2 According to Wyoming, five percent (5%) preference will be given to responsible Wyoming Contractors. The contract shall be let to the responsible resident making the lowest Bid if such resident is not more than five percent (5%) higher than that of the lowest responsible non-resident Bidder.
- 14.3 All contractors wishing to be eligible for the preference on this project must submit with their Bid or have on file with SCSD#2 their "Residency Certification".
- 14.4 A successful resident Bidder shall not subcontract more than twenty percent (20%) of the work covered by his contract to non-resident contractors.
- 14.5 Pursuant to Wyoming Statutes 16-6-203, Labor Standards Wyoming Preference Act apply to submitted bids to the extent required by Law.
 - 14.5.1 Attention of the bidder is directed to the Wyoming Prevailing Wage Act of 1967, pursuant to this Act, not less than the prevailing hourly wages for work under this bid shall be paid to all workers unless otherwise specified in writing by the State Procurement Administrator prior to this bid opening.

- 14.5.2 Attention of the bidder is directed to W.S. 27-4-410 which requires Contractors and all sub-contractors to maintain accurate records showing the names and occupations of all workmen employed and showing the actual wages paid to each of the workmen and is reviewable by the Department of Workforce Services, Labor Standards Division, or the contracting agency, Violation of this section is subject to criminal sanctions.

15. SUBSTITUTIONS:

- 15.1 The materials, products and equipment described in the Bidding Documents establish a standard or required function, dimension, appearance, and quality which must be met by any proposed substitution.
- 15.2 **No substitution will be considered unless written request for approval has been submitted by the Bidder to Architect no later than issuance of the last Addendum.** Each request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment, or work that incorporation of the substitute would require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. Architect's decision of approval or disapproval of a proposed substitution shall be final.
- 15.3 If Architect approves any proposed substitution, such approval will be set forth in Addendum. Bidder shall not rely upon approvals made in any other manner.

16. INSURANCE:

- 16.1 The successful Bidder will be required to purchase, at his own expense, and maintain during the life of the contract, Comprehensive General Liability, Comprehensive Automobile and Worker's Compensation with limits of not less than those set forth below.
- 16.2 The Bidder shall deliver the required Certificate of Insurance prior to the date of execution of the Contract.
- 16.3 Contractor shall procure and maintain at his cost and expense, during the entire period of the contract (including any applicable warranty and/or renewal periods) the types of insurance specified below. All insurance shall be procured from reputable insurers authorized to do business in the State of Wyoming.

General Liability - Commercial	
Bodily Injury	\$2,000,000 each occurrence \$2,000,000 aggregate
Property Damage Liability	\$2,000,000 each occurrence \$2,000,000 aggregate
Excess Liability	\$5,000,000
Automobile Liability (Hired & Non-Owned Auto)	

Combined Single Limits (CSL) \$1,000,000

Workmen's Compensation - As required by law

- 16.4 The policy shall name SCSD#2 as a named insured and shall contain a provision that the policy may not be canceled, terminated or modified without thirty (30) days written notice.
- 16.5 The Contractor shall not commence work on the site until he has obtained all insurance required under the contract nor shall he allow any subcontractor to commence work until all similar insurance required of the subcontractor has been obtained.
- 16.6 The providing of any insurance required herein does not relieve the Bidder of any of the responsibilities or obligations assumed by the Bidder in the Contract awarded, or for which the Bidder may be liable by law or otherwise.

17. **RETAINAGE:**

- 17.1 Five percent (5%) of the total invoice will be held for retainage throughout the entire project.
- 17.2 As according to Wyoming State Statutes the required retainage on contracts of more than \$25,000 shall be placed in an interest-bearing deposit for the contractor. The successful bidder shall contact SCSD#2 to request retainage be placed in an interest-bearing account. Failure of the Contractor to make the proper arrangements for the retainage account shall not obligate the Owner to pay interest on retainage monies not placed in an interest-bearing Account. The retainage will be assigned to the Owner until final acceptance.

BID FORM

Sheridan County School District #2 SHS Family Consumer Science Renovation

Sheridan County School District #2 invites sealed bids for **Sheridan County School District #2 – SHS Family Consumer Science Renovation** in accordance with bid documents. Sealed bids will be received by the District at the Administrative Office, located at 201 North Connor Street, Sheridan, Wyoming, until 10:00 am, local time, Thursday April 18th, 2024, and then publicly opened and read aloud.

As a Bidder I have examined a complete set of Contract documents including all drawings, all specifications and all related contract documents. I have visited the site, understand the intent of the proposed work, and have become familiar with all the conditions surrounding the construction of the proposed project, including the availability of materials and labor. Furthermore, I have confirmed that all subcontractors and suppliers that submitted prices to me have also examined complete sets of Contract Documents including all drawings, all specifications and all related contract documents. Having thoroughly familiarized myself with all requirements of this project, I hereby propose to furnish all labor, equipment, materials, and supplies, and to construct the project in accordance with the Contract Documents, within the time set forth herein, and at the price(s) stated below. These prices are to cover all expenses incurred in the performance of the work required under the Contract Documents.

RECEIPT OF ADDENDA:

Bidders acknowledges receipt of the following Addenda:

_____, _____, _____

BASE BID: All labor, material and associated costs for the completion of the work indicated in the Bid Documents.

Dollars(_____)

(Show amount in both words and figures)

ALTERNATE #1 (LVT Flooring) : All labor, material and associated costs for the completion of the work indicated in the Bid Documents.

Dollars(_____)

(Show amount in both words and figures)

SCHEDULE:

Date of Commencement (not before June 3): _____
(Contractor's date of commencement)

Date of Substantial Completion (not after August 9): _____
(Contractor's date of Substantial Completion)

PRE-BID TOUR:

A MANDATORY pre-bid tour will be held Tuesday April 2, 2024, at 3:30 pm, at the Sheridan High School, 1056 Long Drive, Sheridan, WY.

Bidder acknowledges attendance at the Mandatory pre-bid tour. _____ (initial)

BID BOND:

Each Bid must be accompanied by a Bid Bond payable to Sheridan County School District #2 for ten percent (10%) of the total bid (base bid plus all alternatives, if any). The Bid Bond pledges that the Bidder will enter into a contract with Sheridan County School District #2 on the terms stated in the bid.

PERFORMANCE AND PAYMENT BOND:

The successful Bidder will provide 100% of the contract Performance and Payment Bond or Letter of Credit or any other security as approved by Sheridan County School District #2 as stated in the Instructions to Bidders.

EQUAL OPPORTUNITY EMPLOYER:

Sheridan County School District #2 is an Equal Opportunity Employer and all awards will be governed by the Equal Opportunity Clause.

RIGHT TO AWARD BID:

Bidders will understand that Sheridan County School District #2 reserves the right to accept or reject any or all items, any or all parts, any or all sections, any or all bids as stated in the specifications, to waive any irregularities or informalities, or to re-bid or re-advertise for bids if it is determined to be necessary or desirable, and reserves the right to let the bid in any manner it sees fit. Sheridan County School District #2 will not be bound to accepting the low bid, but rather the bid they feel will be in the best interest of the School District.

The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an agreement with the OWNER, in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Document for the Contract Price, and within the Contract Time indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

The BIDDER accepts all the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders and General Conditions, including without limitation, those dealing with the disposition of Bid Security. The BIDDER will sign and submit the Agreement with the Bonds and other documents required by the Bidding Requirements within ten (10) days after the date of the OWNER's Notice of Award.

I hereby agree that this bid is irrevocable for a period of forty-five (45) days after the date set for the opening of bids.

Authorized Signature

Typed Signature of Bidder

Position

Business Name and Address of Bidder:

(Name)

Phone: _____

(Address)

Fax: _____

SEAL (if by Corporation)

(City, State, Zip)

NOTICE OF AWARD

TO: Company
P.O. Box
City, State, Zip

Sheridan County School District #2 Board of Trustees, at its regular meeting on _____, 2024, awarded the bid for the SCSD2 – SHS FAMILY CONSUMER SCIENCE RENOVATION, to you, _____, in the amount of \$____,____.____.

Please forward the required Contractor's Performance and Payment Bond, Forms of Agreement and Certificates of Insurance within ten (10) calendar days from the date of this Notice of Award to: Mr. Troy Decker, Facilities Director – SCSD#2, 201 N Connor St., Ste. 100, Sheridan, WY 82801.

If you fail to execute said AGREEMENT and to furnish said BONDS within ten (10) days from the date of this Notice, said SHERIDAN COUNTY SCHOOL DISTRICT #2 will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned and as a forfeiture of your BID BOND or CASHIER CHECK. SHERIDAN COUNTY SCHOOL DISTRICT #2 will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to SHERIDAN COUNTY SCHOOL DISTRICT #2.

Dated this ____ day of _____, 2024.

SHERIDAN COUNTY SCHOOL DISTRICT #2

By: _____

Title: _____

ACCEPTANCE OF NOTICE

Receipt of the above notice of award is hereby acknowledged.

By: _____, this ____ day of _____, 2024.

(Contractor)

By: _____

FORM OF AGREEMENT

Project: **SCSD2 – FAMILY CONSUMER SCIENCE RENOVATION**

THIS AGREEMENT is made and effective as of the ____ day of _____, 2024 between **SHERIDAN COUNTY SCHOOL DISTRICT #2** ("Owner") and _____ ("Contractor") for contract work described generally and as described in detail as stated below.

OWNER AND CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1. WORK

- 1.1 CONTRACTOR will complete all work as specified or indicated in the Contract Documents. The CONTRACTOR will furnish all of the structural design calculations and means and methods as well as material, supplies, tools, equipment, labor and other services necessary for the complete design, construction and completion of the WORK as described in the design / build bid documents.
- 1.2 In connection with the work to be performed, CONTRACTOR, at his expense, will procure all necessary permits and licenses and agree to comply with all laws, ordinances, codes, and regulations applicable to the performance of the work hereunder.

ARTICLE 2. CONTRACT TIME

- 2.1 CONTRACTOR agrees to begin design work upon execution of this agreement and construction work _____, 2024 and complete the contract on or before _____, 2024, time being of the essence.

ARTICLE 3. CONTRACT PRICE

- 3.1 For full and complete performance, OWNER agrees to pay CONTRACTOR the sum of \$_____, payable in accordance with the terms hereof and to the satisfaction of the OWNER.

ARTICLE 4. PAYMENT PROCEDURES

- 4.1 CONTRACTOR will submit invoices to **Sheridan County School District #2**.
- 4.2 PROGRESS PAYMENTS. OWNERS can make progress payments on account of the Contract Price. All progress payments will be on the basis of the progress of the work as approved by **Mr. Troy Decker**, OWNER'S representative.
- 4.3 RETAINAGE. OWNERS will have the right to withhold from each payment of the contract price a sums ("retainage") equal to ten percent (10%) of the invoice.
- 4.4 FINAL PAYMENT. Upon final completion and acceptance of the work by the OWNER a final payment to contractor notice will be advertised in The Sheridan Press for a period of forty-one (41) days. Final payment will be processed after such period.

ARTICLE 5. CONTRACTORS' REPRESENTATIONS

- 5.1 CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Work, Site, Locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.
- 5.2 CONTRACTOR agrees to perform all the Work described in the Contract Documents.
- 5.3 CONTRACTOR will furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the Work as described in the Contract Documents.
- 5.4 CONTRACTOR is aware that a Wyoming Licensed Structural Engineer is required to perform the structural calculations and design solutions for the remediation work required.
- 5.5 CONTRACTOR is aware that time is of the essence and that other work under a separate agreement with other contractor(s) is contingent upon his timely completion of the work of this contract, all work will need to be completed as outlined in the special conditions.

ARTICLE 6. CHANGES IN WORK

- 6.1 The OWNER may order changes in the work, the Contract sum being adjusted accordingly. All such orders and adjustments will be in writing and subject to the terms and conditions of this Contract. Claims by the CONTRACTOR for extra cost must be made in writing to the OWNER'S representative and approved by OWNER before executing the work involved.

ARTICLE 7. CONTRACT DOCUMENTS

- 7.1 The Contract Documents which comprise the entire agreement between OWNER and CONTRACTOR concerning the Work consist of the following.
 - 1. Invitation to Bid and Form of Bid
 - 2. Instructions to Bidders
 - 3. General Conditions
 - 4. Technical Specifications
 - 5. Addenda, Bid Specifications and Drawings (Blueprints)
 - 6. Form of Agreement, Notice of Award and Notice to Proceed, Consent of Surety, Contractor's Affidavit, Warranty, Final Completion Documents
 - 7. Bid, Performance and Payment Bond
 - 8. Change Orders

ARTICLE 8. CLEANING

- 8.1 CONTRACTOR will, at his own expense, at all times keep the premises free from accumulation of debris, waste materials, and rubbish, and at the completion of the work, he will remove his tools and equipment and all surplus materials, debris, waste

material, and rubbish and will leave the premises in a neat and clean conditions. If CONTRACTOR does not attend to such cleaning immediately upon request, OWNER will have the right to have this work done by others and deduct the cost therefor from the payment due CONTRACTOR hereunder.

ARTICLE 9. CONTRACTOR'S FAILURE TO PROSECUTE WORK.

- 9.1 Should CONTRACTOR neglect to prosecute the work properly, or fail to perform any provision of the Contract, the OWNERS after seven (7) days written notice to the CONTRACTOR, may, without prejudice to any other remedy it may have, make good the deficiencies and may deduct the cost thereof from the payment then or thereafter due CONTRACTOR or, at its option, may terminate the Contract. If the unpaid balance of the contract price exceeds the expense of finishing the work, such excess will be to CONTRACTOR, but if such expense exceeds such unpaid balance, CONTRACTOR will pay the difference to the OWNER.

ARTICLE 10. DEFECTIVE WORKS

- 10.1 No payment, in whole or in part, will be deemed a waiver of any defect in materials or workmanship, and the OWNER reserves the right to withhold payment pending inspection of the work performed by CONTRACTOR. Notwithstanding payment by OWNER of the sum's due hereunder or failure of the OWNER to discover or reject defective material and workmanship, the CONTRACTOR will re-execute any work that fails to conform to the requirements of the contract and that appears during the progress of the work and will remedy any defects due to faulty materials or workmanship which appears within a period of one year from the date of completion of the contract. The provisions of this article apply to work done by subcontractors as well as work done by direct employees of the CONTRACTOR.

ARTICLE 11. INDEPENDENT CONTRACTOR

- 11.1 CONTRACTOR will at all times be an INDEPENDENT CONTRACTOR in performing the work under this Contract including any additions thereon and will furnish all supervision and direction required to complete the work.
- 11.2 The CONTRACTOR is responsible for all state and federal taxes on payments earned under the agreement and on the earnings paid to any workers hired by the CONTRACTOR.

ARTICLE 12. ASSIGNMENT AND SUBCONTRACTS

- 12.1 The CONTRACTOR will not assign his interest in this contract nor sublet nor subcontract any portion of the work. The CONTRACTOR agrees to bind every subcontractor approved by the OWNER to all of the terms and conditions of this agreement. The CONTRACTOR agrees that he is fully responsible to the OWNER for the acts and omissions of his subcontractor, as CONTRACTOR is for the acts and omissions of himself and of persons directly employed by him.

ARTICLE 13. INDEMNIFICATION

- 13.1 CONTRACTOR agrees to indemnify and save harmless OWNER, and any of its affiliated companies from and against all claims, demands, liabilities, suits, judgments and decrees, losses and costs and/or expenses of any kind or nature whatsoever on account of injuries to or death of any person or persons or damage to any property occurring directly or indirectly from the performance of work hereunder by CONTRACTOR or his employees, agents, servants, associates or subcontractors however such injuries or death or damage to property may be caused.

ARTICLE 14. WAIVE OF CLAIMS, LIENS, ETC.

- 14.1 CONTRACTOR, individually and on behalf of his subcontractors, material men and workers, hereby waives and agrees to indemnify and save harmless the OWNER from all attachments, claims, and liens against OWNER and OWNER's property by reason of labor or materials or both, furnished under this CONTRACT.

ARTICLE 15. MISCELLANEOUS

- 15.1 OWNER and CONTRACTOR each bind it, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of all covenants, agreements and obligations contained in the Contract Documents.

ARTICLE 16. LIQUIDATED DAMAGES

- 16.1 The OWNER and CONTRACTOR recognize that time is of essence in this AGREEMENT. OWNER and CONTRACTOR agree that, as liquidated damages or delay, the CONTRACTOR will pay the OWNER Three Hundred dollars (\$300.00) for each calendar day that expires after the time specified for final completion.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this **AGREEMENT** in triplicate. One counterpart each has been delivered to OWNER and CONTRACTOR. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR.

This **AGREEMENT** will be effective on _____, 2024.

CONTRACTOR _____

By _____

Title _____

Attest _____

OWNER SHERIDAN COUNTY SCHOOL DISTRICT #2

By _____

Title _____

Attest _____

NOTICE TO PROCEED

TO: Contractor

FROM: Sheridan County School District #2
201 N Connor Street, Ste 100
Sheridan, WY

PROJECT: SCSD2 – SHS FAMILY CONSUMER SCIENCE RENOVATION

DATE: _____, 2024

You are hereby notified construction may commence immediately, on _____ in accordance with the Agreement dated _____, 2024, and you are to complete the WORK by _____.

SHERIDAN COUNTY SCHOOL DISTRICT #2

Mr. Troy Decker – Facilities Director

ACCEPTANCE OF NOTICE

Receipt of the above **NOTICE TO PROCEED** is hereby acknowledged by:

_____, this ____ day of _____, 2024,

by _____, title _____

GENERAL CONDITIONS

The agreement and such other Contract Documents as practicable will be executed and delivered by CONTRACTOR to OWNER within ten (10) days of the Notice of Award.

1.0 Execution of the Contract:

1.1.1 By executing the Contract, the CONTRACTOR represents that he has familiarized himself with, and assumes full responsibility for having familiarized himself with, the nature and extend of the Contract Documents, Work, locality, and with all local conditions and federal, state and local laws, ordinances, rules and regulations that may in any manner affect performance of the Work, and represents that he has correlated his study and observations with the requirements of the Contract Documents.

1.2 Delivery of Bonds

1.2.1 When he delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such bonds as he may be required to furnish.

1.3 Commencement of Contract Time; Notice to Proceed

1.3.1 A "Notice to Proceed" will be issued to the CONTRACTOR after all required documents are completed and approved by Sheridan County School District #2.

1.4 Starting the Project

1.4.1 CONTRACTOR shall start to perform his obligations under the Contract Documents on the date when the Contract time commences to run. No work shall be done at the site prior to the date on which the Contract Time commences to run.

1.5 Before Starting Construction

1.5.1 Before starting the Work at the site, CONTRACTOR shall furnish OWNER (Purchasing Office) insurance, bonds, and/or other documents as required.

SECTION 2 - OWNER'S REPRESENTATIVE

2.1 Administration of Contract:

2.1.1 The Architect/Engineer and OWNER's Representative, as stated in the Instructions to Bidders, will administer the contract.

2.1.2 Applications for Payment or invoices shall be submitted to the OWNER and based on his observation and evaluation, the Representative will determine the amounts owing to the Contractor.

2.1.3 The OWNER will have the authority to reject Work which does not conform to the Contract Documents

2.1.4 The OWNER will prepare Change Orders for review and approval.

- 2.1.5 The OWNER will conduct inspections to determine final completion.

SECTION 3 - BONDS AND INSURANCE

3.1 Performance, Payment and Other Bonds

- 3.1.1 Each Bid must be accompanied by a Bid Bond payable to Sheridan County School District #2 for ten percent (10%) of the total amount of the bid, (a certified check may be used in lieu of a Bid Bond) pledging that the Bidder will enter into a contract with Sheridan County School District #2.
- 3.1.2 CONTRACTOR shall furnish Performance and Payment Bonds as security for the faithful performance and payment of all his obligations under the Contract Documents. These bonds shall be in amounts equal to the Contract Price in such form and with such sureties as are licensed to conduct business in the State of Wyoming.
- 3.1.3 If the surety on any Bond furnished by CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in the State of Wyoming, CONTRACTOR shall within five (5) days thereafter substitute another Bond and Surety, both of which shall be acceptable to OWNER.

3.2 Contractor's Liability Insurance

- 3.2.1 CONTRACTOR shall purchase and maintain such insurance as will protect him from claims under workmen's compensation laws, disability benefit laws or other similar employee benefit laws; from claims for damages because of bodily injury, occupational sickness or disease, or death of his employees, and claims insured by usual personal injury liability coverage; from claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees including claims insured by usual personal injury liability coverage; and from claims for injury to or destruction of tangible property, including loss of use resulting therefrom - any or all of which may arise out of or result from CONTRACTOR'S operations under the Contract Documents, whether such operations be by himself or by any subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be legally liable. This insurance shall include the specific coverage and be written for not less than any limits of liability and maximum deductibles specified in the Bid Documents or required by law, whichever is greater, shall include contractual liability insurance and shall include OWNER as additional insurance parties. Before starting the work, CONTRACTOR shall file with OWNER certificates of such insurance, acceptable to OWNER; these certificates shall contain a provision that the coverage afforded under the policies will not be canceled or materially changed until at least thirty (30) days' prior written notice has been given to OWNER.
- 3.2.2 Refer to the Instructions to Bidders under Insurance for specific coverage and amounts.
- 3.2.3 Unemployment and Workmen's Compensation Insurance proof that the Contractor and all subcontractors are still registered with the Employment Security Commission and the Workers Compensation Division at the time of completion of construction shall be submitted prior to the Acceptance of the Project.

SECTION 4 - CONTRACTOR'S RESPONSIBILITIES

4.1 Supervision and Superintendence

- 4.1.1 CONTRACTOR shall supervise and direct the Work efficiently and with his best skill and attention. He shall be solely responsible for the means, methods, techniques, sequences and procedures of construction.
- 4.1.2 CONTRACTOR shall be responsible to see that the finished Work complies accurately with the Contract Documents.
- 4.1.3 CONTRACTOR shall be responsible to the OWNER for the acts and omissions of his employees, subcontractors and their agents and employees and other persons performing any of the Work under a contract with the CONTRACTOR.
- 4.1.2 CONTRACTOR shall keep on the work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER and OWNER'S REPRESENTATIVE. The superintendent will be CONTRACTOR'S representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications given to the superintendent shall be as binding as if given to CONTRACTOR.

4.2 Labor, Materials and Equipment

- 4.2.1 CONTRACTOR shall provide competent, suitably qualified personnel to lay out the Work and perform construction as required by the Contract Documents. He shall at all times maintain good discipline and order at the site. The OWNER maintains the right to disallow any person from the site for any reason including but not limited to: contact with students, discovery of felony criminal record or any misconduct. In case of a worker being requested to be removed, the CONTRACTOR will respond immediately to comply upon notification and will replace the worker as needed to complete the work.
- 4.2.2 All materials and equipment shall be new, except as otherwise provided in the Contract Documents. If required by OWNER, CONTRACTOR shall furnish satisfactory evidence as to the kind and quality of materials and equipment.
- 4.2.3 All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator or processors, except as otherwise provided in the Contract Documents.

4.3 Substitute Materials or Equipment

- 4.3.1 The materials, products and equipment described in the Bidding Documents establish a standard or required function, dimension, appearance, and quality which must be met by any proposed substitution.
- 4.3.2 No substitution will be considered unless written request for approval has been submitted by the Bidder to Architect. Each request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cut, performance and test data, and any other information necessary for an evaluation, as well as a statement setting forth any changes in other

materials, equipment, or work that incorporation of the substitute would require. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final subject to Owner's approval.

4.4 **Concerning Subcontractors**

- 4.4.1 CONTRACTOR shall not employ any subcontractor or other person or organization (including those who are to furnish the principal items of materials or equipment), whether initially or as a substitute, against whom OWNER may have reasonable objection.
- 4.4.2 CONTRACTOR shall submit an acceptable substitute and the Contract Price shall be increased or decreased by the difference in cost occasioned by such substitution, an appropriate Change Order shall be issued.
- 4.4.3 CONTRACTOR shall be fully responsible for all acts and omissions of his subcontractors and of persons and organizations directly or indirectly employed by them and of persons and organizations for whose acts any of them may be liable to the same extent that he is responsible for the acts and omissions of persons directly employed by him. Nothing in the Contract Documents shall create any contractual relationship between OWNER and any subcontractor or other person or organization having a direct contract with CONTRACTOR, nor shall it create any obligation on the part of OWNER to pay or to see to the payment of any monies due any subcontractor or other person or organization, except as may otherwise be required by law. OWNER may furnish to any subcontractor or other person or organization, to the extent practicable, evidence of amounts paid to CONTRACTOR on account of specific work done in accordance with the schedule of values.
- 4.4.4 CONTRACTOR agrees to bind specifically every subcontractor to the applicable terms and conditions of the Contract Document for the benefit of OWNER.

4.6 **Patent Fees and Royalties**

- 4.6.1 CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the work and, if to the actual knowledge of OWNER, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. CONTRACTOR shall indemnify and hold harmless OWNER and anyone directly or indirectly employed by either of them from and against all claims, damages, losses and expenses (including attorneys' fees) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the work or resulting from the incorporation in the work of any invention, design, process, product or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.

4.7 **Permits**

4.7.1 CONTRACTOR shall obtain and pay for all construction permits and licenses and shall pay all charges and inspection fees necessary for the prosecution of the work, which are applicable at the time of his bid.

4.8 **Laws and Regulations**

4.8.1 CONTRACTOR shall give all notices and comply with all laws, ordinances, rules and regulations applicable to the Work. If CONTRACTOR observes that the Specifications or Drawings are at variance therewith, he shall give ARCHITECT prompt written notice thereof, and any necessary changes shall be adjusted by an appropriate Modification. If CONTRACTOR performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to ARCHITECT, he shall bear all costs arising.

4.9 **Taxes**

4.9.1 CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by him in accordance with the law of the place where the work is to be performed.

4.10 **Use of Premises**

4.10.1 CONTRACTOR shall confine his equipment, the storage of materials and equipment and the operations of his workmen to areas permitted by law, ordinances, permits, or the requirements of the Contract Documents, and shall not unreasonably encumber the premises with materials or equipment.

4.10.2 CONTRACTOR shall not load nor permit any part of any structure to be loaded with weights that will endanger the structure, nor shall he subject any part of the work to stresses or pressures that will endanger it.

4.11 **Record Drawings**

4.11.1 CONTRACTOR shall keep one (1) record copy of all Specifications, Drawings, Addenda, Modifications, and Shop Drawings at the site in good order and annotated to show all changes made during the construction process. Two (2) copies shall be delivered to ARCHITECT upon completion of the Project.

4.12 **Safety and Protection**

4.12.1 CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. He shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

- (a) all employees on the work and other persons who may be affected thereby,
- (b) all the work and all materials or equipment to be incorporated therein, whether in storage on or off the site, and

- (c) other property at the site of adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

4.12.2 CONTRACTOR shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss. He shall erect and maintain, as required by the conditions and progress of the work, all necessary safeguards for its safety and protection. All damage, injury or loss to any property referred to in paragraphs (b) or (c) above, caused directly or indirectly, in whole or in part, by CONTRACTOR, any subcontractor or anyone directly or indirectly employed by and of them or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR. CONTRACTOR'S duties and responsibilities for the safety and protection of the work shall continue until such time as all the work is completed.

4.12.3 CONTRACTOR shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents. This person shall be CONTRACTOR'S superintendent unless otherwise designated in writing by CONTRACTOR to OWNER. He shall erect and maintain, as required by the conditions all necessary safeguards for its safety and protection against damage, injury or loss. He shall notify owners of adjacent utilities when prosecution of the work may affect them. All damage, injury or loss to any property referred to in paragraphs (b) or (c) above, caused directly or indirectly, in whole or in part, by CONTRACTOR, any subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR.

4.13 **Shop Drawings and Samples**

4.13.1 After checking and verifying all field measurements, CONTRACTOR shall submit shop drawings for approval. The data shown on the shop drawings will be complete with respect to dimensions, design criteria, materials of construction and the like to enable ARCHITECT to review the information as required.

4.13.2 At the time of each submission, CONTRACTOR shall in writing call ARCHITECT's attention to any deviations that the Shop Drawings or sample may have from the requirements of the Contract Documents.

4.14 **Cleaning**

4.14.1 CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the work, and at the completion of the work he shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by OWNER. CONTRACTOR shall restore to their original condition those portions of the site not designated for alteration by the Contract Documents.

4.15 **Indemnification**

4.15.1 CONTRACTOR shall indemnify and hold harmless OWNER and its agents and employees from and against all claims, damages, losses and expenses including attorneys'

fees arising out of or resulting from the performance of the work, provided that any such claim, damage, loss or expense (a) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the work itself) including the loss of use resulting therefrom and (b) is caused in whole or in part by any negligent act or omission of CONTRACTOR, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.

- 4.15.2 In any and all claims against OWNER or OWNER'S REPRESENTATIVE or any of their agents or employees by any employee of CONTRACTOR, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this section, paragraph one above, shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR or any subcontractor under workmen's compensation acts, disability benefit acts or other employee benefit acts.
- 4.15.3 The obligations of CONTRACTOR under this section, from the first paragraph above, shall not extend to the liability of OWNER, his agents or employees arising out of (a) the preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs or specifications or (b) the giving of or the failure to give directions or instructions by OWNER, his agents or employees provided such giving or failure to give is the primary cause of injury or damage.

SECTION 5 - REJECTING DEFECTIVE WORK

5.1. Rejecting Defective Work

- 5.1.1 ARCHITECT and/or OWNER'S REPRESENTATIVE will have authority to disapprove or reject work which is "defective", which term is hereinafter used to describe work that is unsatisfactory, faulty or defective, or does not conform to the requirements of the Contract Documents or does not meet the requirements of any inspection, test or approval.

SECTION 6 - CHANGES IN THE WORK

6.1 Changes in the Work

- 6.1.1 Without invalidating the Agreement, OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work; these will be authorized by Change Orders. Upon receipt of a Change Order, CONTRACTOR shall proceed with the work involved. All such work shall be executed under the applicable conditions of the Contract Documents. If any Change Order causes an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, an equitable adjustment will be made.
- 6.1.2 Additional work performed by Contractor without authorization of a Change Order will not entitle him to an increase in the Contract Price or an extension of the Contract Time.
- 6.1.3 It is the CONTRACTOR'S responsibility to notify his surety of any changes affecting the general scope of the work or change in the Contract Price and the amount of the

applicable bonds shall be adjusted accordingly. CONTRACTOR shall furnish proof of such adjustment to OWNER.

SECTION 7 - CHANGE OF CONTRACT PRICE

7.1 Change of Contract Price

- 7.1.1 The Contract Price constitutes the total compensation payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at his expense without change in the Contract Price.
- 7.1.2 The Contract Price may only be changed by a Change Order. Any claim for an increase in the Contract Price shall be based on written notice delivered to Owner. All claims for adjustments must be approved by the OWNER.

SECTION 8 - CHANGE OF THE CONTRACT TIME

8.1 Change of the Contract Time

- 8.1.1 The Contract Time may only be changed by a Change Order. Any claim for an extension in the Contract Time shall be based on written notice delivered to Owner.

SECTION 9 -WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

9.1 Warranty and Guarantee

- 9.1.1 CONTRACTOR warrants and guarantees to OWNER that all materials and equipment will be new unless otherwise specified and that all work will be of good quality and free from faults or defects and in accordance with the requirements of the Contract Documents. All unsatisfactory work, all faulty or defective work, and all work not conforming to the requirements of the Contract Documents at the time of acceptance thereof or of such inspections, tests or approvals, shall be considered defective. Prompt notice of all defects shall be given to CONTRACTOR. All defective work, whether or not in place, may be rejected, corrected or accepted.

9.2 Tests and Inspections

- 9.2.1 If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any work to specifically be inspected, tested, or approved by some public body, CONTRACTOR shall assume full responsibility therefor, pay all costs in connection therewith and furnish OWNER'S REPRESENTATIVE the required certificates of inspection, testing or approval.
- 9.2.3 CONTRACTOR shall give OWNER timely notice of readiness of the work for all inspections, tests, or approvals. If any such work required so to be inspected, tested or approved is covered without written approval, it must, if requested by OWNER, be uncovered for observation, and such uncovering shall be at CONTRACTOR'S expense unless CONTRACTOR has given OWNER timely notice of his intention to cover such work and Owner has not acted with reasonable promptness in response to such notice.

- 9.2.4 Neither observations by OWNER, nor inspections, tests or approvals by persons other than CONTRACTOR, shall relieve CONTRACTOR from his obligations to perform the Work in accordance with the requirements of the Contract Documents.

9.3 **Uncovering Work**

- 9.3.1 If any work is covered contrary to the written request of OWNER, it must, if requested by OWNER, be uncovered for his observation and replaced at CONTRACTOR'S expense.
- 9.3.2 If any work has been covered which OWNER has not specifically requested to observe prior to its being covered, or if OWNER considers it necessary or advisable that covered work be inspected or tested by others, CONTRACTOR, at OWNER'S request, shall uncover, expose or otherwise make available for observation, inspection or testing as OWNER may require, that portion of the work in question, furnishing all necessary labor, material and equipment. If it is found that such work is defective, CONTRACTOR shall bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction, including compensation for additional professional services, and an appropriate deductive Change Order shall be issued. If, however, such work is not found to be defective, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction if he makes a claim therefor.

9.4 **Owner May Stop the Work**

- 9.4.1 If the work is defective, or CONTRACTOR persistently fails to carry out the Work in accordance with the Contract Documents, or fails to supply sufficient skilled workmen or suitable materials or equipment, or if CONTRACTOR fails to make prompt payments to subcontractors or for labor, materials or equipment, OWNER may order CONTRACTOR to stop the work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the work shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR or any other party.

9.5. **Correction or Removal of Defective Work**

- 9.5.1 If required by OWNER prior to approval of final payment, CONTRACTOR shall promptly, without cost to OWNER either correct any defective work, whether or not fabricated, installed or competed, or, if the work has been rejected by OWNER, remove it from the site and replace it with non-defective work. If CONTRACTOR does not correct such defective work or remove and replace such rejected work within a reasonable time, all as specified in a written notice from OWNER, OWNER may have the deficiency corrected or the rejected work removed and replaced. All direct or indirect costs of such correction or removal and replacement, including compensation for additional professional services, shall be paid by CONTRACTOR, and an appropriate deductive Change Order shall be issued. CONTRACTOR shall also bear the expenses of making good all work of others destroyed or damaged by his correction, removal or replacement of his defective work.

9.6 **One (1) Year Correction Period**

9.6.1 If, after the approval of final payment and prior to the expiration of one (1) year after the date of substantial completion or such longer period of time as may be prescribed by law or by the terms of any applicable special guarantee required by the Contract Documents, any work is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER'S written instructions, either correct such defective work, or, if it has been rejected by OWNER, remove it from the site and replace it with non-defective work. If CONTRACTOR does not promptly comply with the terms of such instruction, OWNER may have the defective work corrected or the rejected work removed and replaced, and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, shall be paid by CONTRACTOR.

9.7 **Acceptance of Defective Work**

9.7.1 If, instead of requiring correction or removal and replacement of defective work, OWNER (and, prior to approval of final payment) prefers to accept it, he may do so. In such case, if acceptance occurs prior to approval of final payment, a Change Order shall be issued incorporating the necessary revisions in the Contract Documents, including appropriate reduction in the Contract Price; or, if the acceptance occurs after approval of final payment, an appropriate amount shall be paid by CONTRACTOR to OWNER.

9.8 **Neglected Work by Contractor**

9.8.1 If CONTRACTOR should fail to prosecute the work in accordance with the Contract Documents, including any requirements of the progress schedule, OWNER, after seven (7) days' written notice to CONTRACTOR may, without prejudice to any other remedy he may have, make good such deficiencies and the cost thereof (including compensation for additional professional services) shall be charged against CONTRACTOR if OWNER approves such action, in which case a Change Order shall be issued incorporating the necessary revisions in the Contract Documents including an appropriate reduction in the Contract Price. If the payments then or thereafter due CONTRACTOR are not sufficient to cover such amount, CONTRACTOR shall pay the difference to OWNER.

SECTION 10 - PAYMENTS AND COMPLETION

10.1 **Payment**

10.1.1 Invoices for payment can be submitted once a month for payment for work completed as of the date of the invoice to the OWNER, state herein.

10.2 **Contractor's Warranty of Title**

10.2 CONTRACTOR warrants and guarantees that title to all work, materials and equipment covered by any Application for Payment or invoice, whether incorporated in the Project or not, will pass to OWNER at the time of payment free and clear of all liens, claims, security interests and encumbrances (hereafter in these General Conditions referred to as "Liens").

10.3 **Approval of Payments**

10.3.1 OWNER will, within ten (10) days after receipt of each invoice either indicate in writing his approval of payment or return the invoice to CONTRACTOR indicating in writing his reasons for refusing to approve payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the invoice.

10.3.2 OWNER may refuse to approve the whole or any part of any payment if, in his opinion:

- (a) the work is defective, or completed work has been damaged requiring correction or replacement,
- (b) claims or liens have been filed or there is reasonable cause to believe such may be filed,
- (c) the Contract Price has been reduced because of Modifications,
- (d) CONTRACTOR has been required to correct defective work or complete the work,
- (e) of unsatisfactory prosecution of the work, including failure to furnish acceptable submittal or to clean up.

10.4 **Final Inspection**

10.4.1 Upon written notice from CONTRACTOR that the Project is complete, OWNER will make a final inspection with CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to remedy such deficiencies.

10.5 **Final Application for Payment**

10.5.1 After CONTRACTOR has completed all such corrections to the satisfaction of OWNER and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection and other documents -- all as required by the Contract Documents, he may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied by such data and schedules as OWNER may reasonably require, together with complete and legally effective releases or waivers (satisfactory to OWNER) of all Liens arising out of the Contract Documents and the labor and services performed and the material and equipment furnished thereunder. In Lieu thereof and as approved by OWNER, CONTRACTOR may furnish receipts or releases in full; an affidavit of CONTRACTOR that the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the work for which OWNER or his property might in any way be responsible, have been paid or otherwise satisfied; and consent of the Surety, if any, to final payment. If any subcontractor materialman, fabricator or supplier fails to furnish a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify him against any Lien.

10.6 **Waiver of Claims**

10.6.1 The making and acceptance of final payment shall constitute:

- (a) a waiver of all claims by OWNER against CONTRACTOR other than those arising from unsettled Liens, from defective work appearing after final inspection, or from failure to comply with the requirements of the Contract Documents or the terms of any special guarantees specified therein, and
- (b) a waiver of all claims by CONTRACTOR against OWNER other than those previously made in writing and still unsettled.
- (c) the OWNER has advertised in the local newspaper three (3) times over a period of forty-one (41) days that Final Payment is being requested by the CONTRACTOR for said project.

SECTION 11 - SUSPENSION OF WORK AND TERMINATION

11.1 **Owner may Terminate**

11.1.1 If CONTRACTOR is adjudged a bankrupt or insolvent, or if he makes a general assignment for the benefit of his creditors, or if a trustee or receiver is appointed for CONTRACTOR or for any of his property, or if he files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or similar laws, or if he repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment, or if he repeatedly fails to make prompt payments to subcontractors or for labor, materials or equipment or if he disregards laws ordinances, rules, regulations or orders of any public body having jurisdiction, or if he disregards the authority of OWNER, or if he otherwise violates any provision of the Contract Documents, then OWNER may, without prejudice to any other right or remedy and after giving CONTRACTOR and his Surety seven (7) days' written notice, terminate the services of CONTRACTOR and take possession of the Project and of all materials, equipment, tools, construction equipment and machinery thereon owned by CONTRACTOR, and finish the work by whatever method he may deem expedient. In such case CONTRACTOR shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the Contract Price exceeds the direct and indirect costs of completing the Project, including compensation for additional professional services, such excess shall be paid to CONTRACTOR. If such costs exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such costs incurred by OWNER shall be determined by OWNER and incorporated in a Change Order.

11.1.2 Where CONTRACTOR'S services have been so terminated by OWNER, said terminations shall not affect any rights of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of monies by OWNER due CONTRACTOR will not release CONTRACTOR from liability.

11.1.3 Upon seven (7) days' written notice to CONTRACTOR, OWNER may, without cause and without prejudice to any other right or remedy, elect to abandon the Project and terminate the Agreement. In such case, CONTRACTOR shall be paid for all work executed and any expense sustained plus a reasonable profit.

CONSTRUCTION BID DOCUMENTS

DEFINITIONS

Wherever used in these General Conditions or in the other contract documents, the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1. **Addenda**

Written or graphic instruments issued by the Owner, Architect, or Engineer prior to the execution of the Contract which modify or interpret the bidding documents by additions, deletions, clarifications or corrections.

2. **Agreement**

Written agreement between OWNER and CONTRACTOR covering the work to be performed; other contract documents are attached to the agreement.

3. **Alternate Bid**

An amount stated in the Bid to be substituted for the Base Bid if the corresponding change in project scope or materials or methods of construction described in the Bidding Documents is accepted.

4. **Application for Payment**

A form furnished by ARCHITECT to be used by CONTRACTOR in requesting progress payments and an affidavit of CONTRACTOR that progress payments theretofore received on account of the work have been applied by CONTRACTOR to discharge in full all of CONTRACTOR'S obligations reflected in prior applications for payment.

5. **Owner/Architect**

The principal owner or architect under contract with or in the employ of SCSD2 who prepared the working drawings and/or specifications of the work and who, depending on the terms of his engagement might or might not be responsible for the supervision of the Contractor's performance of the work.

6. **Base Bid**

The sum stated in the Bid for which the Bidder offers to perform the Work described.

7. **Bid**

The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the work to be performed.

8. **Bidder**

One who submits a Bid for a prime contract with the Owner for the Work described in the proposed Contract Documents.

9. **Bidding Documents**

Include the Advertisement to Bid, Instructions to Bidders, Form of Bid, and all of the Contract Documents including any Addenda issued prior to receipt of bids.

10. **Bonds**

Bid, performance and payment bonds and other instruments of security, furnished by CONTRACTOR and his surety in accordance with the contract documents.

11. **Change Order**

Written order to CONTRACTOR signed by OWNER authorizing an addition, deletion or revision in the work or an adjustment in the contract price or the contract time issued after execution of the agreement.

12. **Contract Documents**

The Agreement, Addenda (whether issued prior to the opening of bids or the execution of the agreement), Instructions to Bidders, CONTRACTOR'S Bid (Form of Bid), Bonds, Notice of Award, Notice to Proceed, these General Conditions, Supplementary Conditions, Specifications, Drawings and Modifications.

13. **Contract Price**

Total monies payable to CONTRACTOR under the Contract Documents.

14. **Contract Time**

The number of days stated in the Agreement for the completion of the work.

15. **Contractor**

The person, firm or corporation with whom OWNER has executed the Agreement.

16. **Day**

A calendar day of twenty-four (24) hours measured from midnight to the next midnight.

17. **Drawings**

The drawings which show the character and scope of the work to be performed and which have been prepared or approved by SCSD2 and are referred to in the Contract Documents.

18. **Engineer**

The person, firm or corporation named as such in the Agreement representing SCSD2.

19. **Inspector**

An employee of SCSD2 assigned to inspect the Contractor's performance of the work.

20. **Modification**

(a) A written amendment of the Contract Documents signed by both parties,
(b) a Change Order,
(c) a written clarification or interpretation issued by the Architect or SCSD2, or
(d) a written order for a minor change or alteration in the work issued by Architect.
A modification may only be issued after execution of the Agreement.

21. **Notice of Award**

Written notice by OWNER to the apparent successful bidder stating that upon compliance with the conditions precedent to be fulfilled by him within the time specified, OWNER will execute and deliver the Agreement to him.

22. **Notice to Proceed**

Written notice given by OWNER to CONTRACTOR fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform his obligations under the Contract Documents.

23. **OWNER**

Sheridan County School District #2.

24. **OWNER'S REPRESENTATIVE**

SCSD2's representative for the project as listed in the "Instructions to Bidders".

25. **Project**

The total construction of the Work to be performed as provided in the Contract Documents.

26. **Purchaser**

(Same as "Owner")

27. **Purchase Order**

An enforceable contract in that it is written evidence of the purchaser's acceptance of the seller's previous and unretracted offer to perform the work subject to the purchase order for the price stated herein.

28. **Representative**

An employee of the Owner assigned to inspect and coordinate the Contractor's performance of work.

29. **Seller**

(Same as "Contractor")

30. **Shop Drawings**

All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by CONTRACTOR, a subcontractor, manufacturer, supplier or distributor and which illustrate the equipment, material or some portion of the Work.

31. **Specifications**

Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work.

32. **Subcontractor**

An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

33. **Substantial Completion**

The date as certified by OWNER when the construction of the Project or a specified part thereof is sufficiently completed, in accordance with the Contract Documents, so that the Project or specified part can be utilized for the purposes for which it was intended.

34. **Supplier**

An individual, firm or corporation which over the counter or under contract furnished the Contractor material or equipment incorporated in the work or otherwise incident to the Contractor's performance, but which performs no labor at the work site.

35. **Work**

Any and all obligations, duties and responsibilities necessary to the successful completion of the Project assigned to or undertaken by CONTRACTOR under the Contract Documents, including all labor, materials, equipment and other incidentals, and the furnishing thereof.

DATE

**MR. TROY DECKER – FACILITIES DIRECTOR
SHERIDAN COUNTY SCHOOL DISTRICT #2
201 N CONNOR STREET, SUITE 100
SHERIDAN, WY 82801**

RE: SCSD2 – FAMILY CONSUMER SCIENCE RENOVATION

Dear **MR. DECKER:**

CONTRACTOR NAME hereby certifies the materials supplied under the work of this project are asbestos-free. This includes the following:

Examples...

Insulations

Adhesives

Sealants

Thermal Insulation Expanding Foam

Gypsum Board Products

Tile and Tile Setting Products

Acoustical Panels

Resilient Base & Accessories

Resilient Sheet Flooring

Sheet Carpeting

Impact Resistant Wall Protection (stainless steel corner guards)

Paints/Coatings

Enclosed: Product data sheets for materials listed above.

Substantial Completion Date: **xx/xx/2024.**

Legal Contractor Name

Authorized Signature

Printed Name

Company Title

Date of Signature

SPECIAL CONDITIONS

Project Schedule

Onsite Construction Start: June 3, 2024
Completion: August 9, 2024

Liquidated Damages

The Contractor agrees to pay the Owner liquidated damages as outlined in the schedule below as a reasonable estimate of damages. Refer to the Conditions of the Contract (General and Supplemental) for further information.

Three Hundred Dollars per Calendar Day (\$300/day)

Asbestos Free Provisions

The Architect has prepared the Bidding Documents with every effort to avoid any material which contains asbestos.

The Contractor and every Subcontractor shall be responsible for verification that all materials supplied under the work of this project shall be asbestos-free. If the Contractor or Subcontractor discovers that any specified product contains asbestos, he shall notify the Architect under the Conditions of the paragraphs entitled "Interpretation or Correction of Bidding Documents" found in the Instructions to Bidders.

Asbestos-free certifications, signed by the appropriate Subcontractor and the Contractor, are required for the following specification sections as they apply to this project.

- Adhesives
- Insulations
- Grouts
- Sealants
- Paints/Coatings

Certifications may be required for other sections upon the Architect's request.

CONTRACTOR'S LETTER

Final Completion Inspection

Arete Design Group
228 East Brundage Street, Suite 100
Sheridan, WY 82801

Re: **SCSD2 – SHS Family Consumer Science Renovation**

Dear Arete Design Group:

We hereby certify that the above-referenced project will be ready for Final Completion Inspection on _____, 2024, beginning at _____ (time).

We, therefore, request your inspection. Our Superintendent will be present.

Please find attached to this letter the list of items to be completed or corrected (“punch list”), which has been responded to in its entirety and each individual item annotated with our initials and the date the item was completed or corrected.

We understand that if the project is not ready for inspection, the Contractor shall pay for the time and expenses of the Architect and his consultants.

Sincerely,

By: _____

Title: _____

Company Name: _____

Business Address: _____

Signature: _____

END OF CONTRACTOR'S LETTER: FINAL COMPLETION INSPECTION

CONTRACTOR'S AFFIDAVIT

STATE: WYOMING

CITY: SHERIDAN

COUNTY: SHERIDAN

DATE: _____

I CERTIFY TO THE BEST OF MY KNOWLEDGE AND BELIEF THAT ALL WORK HAS BEEN performed and materials supplied in strict accordance with the terms and conditions of the corresponding contract document between Sheridan County School District #2, the Owner, and _____, the Contractor, dated _____, 2024 for the **SCSD2 – SHS FAMILY CONSUMER SCIENCE RENOVATION** and further declare that all bills, for materials, supplies, utilities and for all other things furnished or caused to be furnished by the above-named contract and used in the execution of the above contract have been fully paid, and that there are no unpaid claims or demands of State Agencies, subcontractor, material men, mechanics, laborers or any other resulting from or arising out of any work done or ordered to be done by said contractor under the above identified contract.

In consideration of the prior and final payments made and all payment made for authorized changes, the contractor releases and forever discharged the OWNER from any and all obligations and liabilities arising by virtue of said contract and authorized changes between the parties hereto, either verbal or in writing, and any and all claims and demands of every kind and character whatsoever against the OWNER, arising out of or in any way relating to said contract and authorized changes.

Lien Releases from all subcontractors and material suppliers are attached to and made part of this Release.

This statement is made for the purpose of inducing the OWNER to make FINAL PAYMENT under the terms of the contract, relying on the truth and statements contained therein.

CONTRACTOR

DATE

CITY

STATE

ZIP CODE

SIGNED BY _____

TITLE _____

Subscribed and sworn to before me this ____ day of _____, 2024.

NOTARY PUBLIC

My Commission Expires: _____

CONSENT OF SURETY TO FINAL PAYMENT

PROJECT: **SCSD2 – SHS FAMILY CONSUMER SCIENCE RENOVATION**

TO: **Sheridan County School District #2**
 (Owner)

CONTRACTOR:

CONTRACT DATE:



In accordance with the provisions of the Contract between Sheridan County School District #2 and Contractor _____, as indicated above the _____ Surety Company on the bond of _____ Contractor _____, _____ Address _____, _____ City, ST ZIP _____, CONTRACTOR, hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor will not relieve the Surety Company of any of its obligations to Sheridan County School District #2, OWNER, as set forth in the said Surety Company's bond.

IN WITNESS WHEREOF, _____, the Surety Company has hereunto set its hand this _____ day of _____, 2024.

Surety Company

Signature of Authorized Representative

Attest

Title

(SEAL)

CERTIFICATE OF FINAL COMPLETION

PROJECT: SCSD2 – SHS FAMILY CONSUMER SCIENCE RENOVATION

CONTRACTOR:

CONTRACT DATE:

This **Certificate of Final Completion** applies to all Work under the Contract Documents, or to the following specified parts thereof:

To: Sheridan County School District #2

And to (Contractor):

The Work to which this Certificate applies has been inspected by authorized representative of the OWNER and CONTRACTOR, and that Work is hereby declared to be complete in accordance with the Contract Documents on _____, 2024.

The project has been advertised according to Wyoming State Statutes 16-6-116, and Affidavit on Behalf of Contractor document is attached to and made a part of this Certificate.

Executed by Owner or Architect on _____, 2024.

(Owner or Owner's Representative)

CONTRACTOR accepts this **Certificate of Final Completion** on _____, 2024.

CONTRACTOR

By _____

OWNER accepts this **Certificate of Final Completion** on _____, 2024.

SHERIDAN COUNTY SCHOOL DISTRICT #2

By _____

WARRANTY

_____, here-in-after the **CONTRACTOR**, does expressly affirm, promise and guarantee the Work performed for **SCSD2 – SHS FAMILY CONSUMER SCIENCE RENOVATION** as described in the Bid Documents, including materials equipment and workmanship for a period of one (1) year from the date the Work was accepted by the Certificate of Final Completion.

CONTRACTOR further agrees in the event that any or all of the Work fails to conform to the Bid Documents or require any maintenance, rebuilding, construction or reconstruction to keep the Work in conformity with the Bid Documents or to bring the Work up to the Bid Document Specifications the **CONTRACTOR** will be responsible for all necessary costs whatsoever.

Sheridan County School District #2 shall give written notice to the **CONTRACTOR** stating the cause or kind of non-conformity.

Dated this ____ day of _____, 2024.

CONTRACTOR

BY _____

STATE OF WYOMING COUNTY OF SHERIDAN

The foregoing instrument was acknowledged before me by _____ this
____ day of _____, 2024.

Notary Public

My Commission Expires: _____

SEAL

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Access to site.
3. Coordination with occupants.
4. Work restrictions.
5. Specification and Drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

- A. Project Identification: Sheridan County School District No. 2 – Sheridan High School Family Consumer Science Renovation.
- B. Owner: Sheridan County School District No. 2, 201 N Connor Street, Sheridan, WY 82801.
1. Owner's Representative: Mr. Troy Decker – Facilities Director.
- C. Architect: Arete Design Group, 228 E. Brundage Street, Suite 100, Sheridan, WY 82801.

1.3 ACCESS TO SITE

- A. Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Driveways, Walkways, and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period at the conclusion of each work day. Repair any damage caused by construction operations.

1.4 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's busy day-to-day operations from 6:00AM to 5:30PM. Maintain existing exits unless otherwise indicated.

1.5 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: 6:00AM to 5:30PM Monday through Friday. Saturday and Sunday hours to be scheduled with Owner. The site will have nearly constant traffic and activity during the hours mentioned above while summer school and sports are in session.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Restricted Substances: Use of tobacco products and other controlled substances on Project sites is not permitted. All Sheridan County School District No. 2 properties are No-smoking, drug free zones.
- E. Restricted Contact: Contact with students is not permitted by any of your or your subcontractor workers. Any worker making contact with a student will be asked to leave the jobsite.

1.6 SCHEDULE

- A. The construction can begin after **June 3, 2024**. Substantial completion must be by **August 9, 2024**. Final completion (all punchwork done) by September 6, 2023.
- B. The 2023-2024 school year ends May 31, 2024. The 2024-2025 school year begins August 27, 2024.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the 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. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.
 - 3. Order of alternates in the list does not imply importance. Owner will chose to accept any alternates they deem viable in any combination as they can fit it within their budget.

1.3 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. Execute accepted alternates under the same conditions as other work of the Contract.
- C. Schedule: A schedule of alternates is included at the end of this Section. 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

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: LVT Flooring

1. Base Bid: Polished Concrete flooring as shown on A901.
2. Alternate: Add LVT flooring instead of polished concrete as shown on A901 and A922.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit electronic copy 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. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions 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 substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions 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 date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. 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.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven 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 seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.

- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 10 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on form provided by the Architect.

1.5 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on form provided by the Architect. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Arrange schedule of values consistent with format of form in the Project Manual.
 - 2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of ten percent of the Contract Sum.
 - 3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 - 4. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
 - 5. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
 - 6. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the time of the month indicated in the Agreement between the Owner and Contractor. The period covered by each Application for Payment is one month.
- D. Application for Payment Forms: Use form in the Project Manual for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- F. Transmittal: Submit three signed and notarized original paper copies of each Application or electronic copy for Payment to Architect by a method ensuring receipt. Include one copy of waivers of lien and similar attachments when required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).

4. Products list (preliminary if not final).
 5. List of Contractor's staff assignments.
 6. List of Contractor's principal consultants.
 7. Copies of building permits.
 8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 9. Initial progress report.
 10. Report of preconstruction conference.
 11. Certificates of insurance and insurance policies.
 12. Performance and payment bonds.
 13. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. Executed Contractor's Affidavit form in the Project Manual
 5. All Final Waivers or Lien
 6. Consent of Surety
 7. Evidence that claims have been settled.
 8. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. RFIs.
 - 3. Digital project management procedures.
 - 4. Project meetings.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.3 DEFINITIONS

- A. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. 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, telephone number, and email address 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.

1.5 GENERAL COORDINATION PROCEDURES

- 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 to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities 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. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
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 information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 3:00 p.m. mountain time will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 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 Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within seven calendar days of receipt of the RFI response.
- E. 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 returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- 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 calendar days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Architect's Digital Data Files: Upon request electronic copies of digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
 - 1. Architect will furnish Contractor one set of digital data drawing files on Compact Disk or flash drive of the Contract Drawings for use in preparing Shop Drawings and one set of PDF documents for use in preparing as-built drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files or PDF files as they relate to the Final Contract Drawings.
 - b. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
 - c. Architect will not issue documents directly to the Contractor's Sub-contractors, suppliers or installers.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
- B. Preconstruction Conference: Schedule and conduct 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.
 - 1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. 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. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.

- i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Preparation of Record Documents.
 - o. Use of the premises and existing building.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. Progress cleaning.
 - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Progress Meetings: Conduct progress meetings at weekly intervals, unless otherwise agreed upon by the Owner and Architect.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. 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 meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. 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) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of 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.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Construction schedule updating reports.
 - 3. Daily construction reports.
 - 4. Site condition reports.

1.2 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 Activity: An activity on the critical path that 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF file.
 - 3. Three paper copies, of sufficient size to display entire period or schedule, as required.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, 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 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 each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at weekly intervals.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 - 1. Use Scheduling component of Project website software specified in Section 013100 "Project Management and Coordination," for current Windows operating system.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial 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 floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 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.
 - a. Doors and Hardware
 - b. Access Control Hardware
 - c. Security Equipment
 - d. Cameras
 - e. Servers
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 - 4. Startup and Testing Time: Include no fewer than 7 days 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.
 - 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final 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. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 - 3. 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.
- 4. Other Constraints: Scheduled Owner events that preclude construction activities from occurring.
- 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. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule at 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 final completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. 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.

1.6 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.7 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. Testing and inspection.
 - 8. Accidents.
 - 9. Meetings and significant decisions.
 - 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. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 2. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 4. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Upon request electronic copies of digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
 - 1. Architect will furnish Contractor one set of digital data drawing files on Compact Disk or flash drive of the Contract Drawings for use in preparing Shop Drawings and one set of PDF documents for use in preparing as-built drawings.

- a. Architect makes no representations as to the accuracy or completeness of digital data drawing files or PDF files as they relate to the Final Contract Drawings.
 - b. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
 - c. Architect will not issue documents directly to the Contractors Sub-contractors, suppliers or installers.
- B. 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 REQUIRING COLOR SELECTIONS shall be submitted as early in the project as possible. Architect will retain all submittals requiring color selections until ALL such submittals have been submitted. The Architect will then prepare coordinated color selections to be approved by the Owner. Upon approval of the color selections by the Owner, the Architect will process the submittal(s) requiring color selections. All submittals requiring color selections shall be accompanied by actual samples of the color and finish selection options. Printed or electronic renditions of the color choices are not acceptable, do not accurately portray true colors, and therefore cannot be used by the Architect to present the coordinated color choices to the Owner. For this reason, only true samples of the actual finish materials will be accepted for color selections. The Architect is not responsible for the delays caused by the failure of the Sub-Contractor or Supplier to submit the correct color samples. The Architect reserves the right to be reimbursed for time and expense required to gather appropriate color samples when proper color samples are not submitted.
- C. Processing Time: Allow 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. Direct Transmittal to Consultant is not allowed. All submittals are to be transmitted to the Architect.
 2. Initial Review: Allow 15 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.
 3. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow 21 days for initial review of each submittal.
 4. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 5. Resubmittal Review: Allow 15 days for review of each resubmittal.

- D. Electronic Submittals: UNLESS OTHERWISE APPROVED BY THE OWNER AND ARCHITECT, ALL SUBMITTALS SHALL BE IN DIGITAL FORMAT AND SUBMITTED ELECTRONICALLY, EXCEPT FOR PRODUCT AND COLOR SAMPLES. Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use Specification Section number followed by a hyphen and then a sequential number along with spec title. (e.g., 061000-1 Rough Carpentry – PD, 061000-2 Rough Carpentry - SD). Resubmittals shall include “R” and sequential number (e.g. 061000-1 R1 Rough Carpentry-PD, 061000-2 R1 Rough Carpentry - SD).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner and Architect, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Indication of full or partial submittal.
 - o. Submittal and transmittal distribution record.
 - p. Other necessary identification.
 - q. Remarks.
 5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- E. Paper Submittals: PAPER SUBMITTALS WILL NOT BE ACCEPTED UNLESS APPROVED IN ADVANCE BY THE ARCHITECT. CONTACTOR SHALL PROVIDE JUSTIFICATION FOR

SUBMITTING PAPER COPY IN LIEU OF ELECTRONIC COPY. ARCHITECT RESERVES THE RIGHT TO BE REINBURSED BY THE CONTRACTOR FOR REVIEW OF PAPER COPY. If the submission of paper copy submittals is approved, place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 3-inches by 5-inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - f. Name 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., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.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.
4. Quantities Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 - a. Submit four copies of each paper submittal which will be retained by the Architect and Owner, plus the number of copies that the Contractor expects to receive back from the Architect after review of the submittal.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review submittals received from sources other than Contractor.
 - a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
 - 1) Project name.
 - 2) Date.
 - 3) Destination (To:).
 - 4) Source (From:).
 - 5) Name and address of Architect.
 - 6) Name of Contractor.
 - 7) Name of firm or entity that prepared submittal.

- 8) Names of subcontractor, manufacturer, and supplier.
 - 9) Category and type of submittal.
 - 10) Submittal purpose and description.
 - 11) Specification Section number and title.
 - 12) Specification paragraph number or drawing designation and generic name for each of multiple items.
 - 13) Drawing number and detail references, as appropriate.
 - 14) Indication of full or partial submittal.
 - 15) Submittal and transmittal distribution record.
 - 16) Remarks.
 - 17) Signature of transmitter.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations: Identify deviations from the Contract Documents on submittals. Failure to identify deviations from the Contract Documents is grounds for rejection of the entire submittal, and rejection of completed work.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Resubmittals shall bear the original submittal number with a designator indicating the number of times the submittal has been resubmitted.
 2. Note date and content of previous submittal.
 3. Note date and content of revision in label or title block and clearly indicate extent of revision.
 4. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- I. 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.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements:
1. Post electronic submittals as PDF electronic files directly to Project Web site, Google Drop Box or other approved data storage location specifically established for Project. Contractor shall bear the cost (if any) of the storage location or system used for submittals and other construction paperwork. Establish notification system with Architect to alert Architect, Contractor and Owner when submittals are posted.
 - a. Architect will return annotated file to the data storage location. Annotate and retain one copy of file as an electronic Project record document file.

2. Certificates and Certifications Submittals: Provide a 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.
 - a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
- 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 published 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 catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data in the following format:
 - a. PDF electronic file.
- 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. Shop drawings that are prepared specifically for this project may be rejected.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.

- f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
- 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 applicable Specification Section.
 - 3. Digital representations of samples will NOT be accepted. Actual samples that display true color, texture and composition of the material sample are required.
 - 4. 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.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 5. 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 one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will not return unused samples.
 - 6. 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. Mark up and retain one returned Sample set as a project record sample.
 - 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: 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. Submit product schedule in the following format:
 - a. PDF electronic file.
- F. Coordination Drawings Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."
- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- N. Installer Certificates: Submit 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.
- O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. Material Test Reports: Submit 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.
- S. Product Test Reports: Submit written reports indicating that 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.
- T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- U. Schedule of Tests and Inspections: Comply with requirements specified in Section 014000 "Quality Requirements."
- V. Preconstruction Test Reports: Submit 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.
- W. Compatibility Test Reports: Submit 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.
- X. Field Test Reports: Submit written reports 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.
- Y. Design Data: Prepare and submit 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.

2.2 DELEGATED-DESIGN SERVICES

- 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 Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic files and certifications, 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.
 2. Where required by the Construction Documents or by Wyoming State Statute, the design professional shall be licensed with the State of Wyoming.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Contractor shall 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. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- C. 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 revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
1. NO EXCEPTIONS TAKEN: Architect has reviewed the submittal for general conformance to the design concept and Construction Documents and takes no exception to the information submitted.
 2. MAKE CORRECTIONS NOTED: Architect has reviewed the submittal for general conformance to the design concept and Construction Documents and releases the submittal for use with the corrections noted.
 3. REVISE AND RESUBMIT: Architect has reviewed the submittal for general conformance to the design concept and Construction Documents and finds the submittal lacking information or needing additional information before release for use.

4. REJECTED: Architect has reviewed the submittal for general conformance to the design concept and Construction Documents and finds the submittal unacceptable. Contractor shall resubmit acceptable information.
 5. SUBMIT SPECIFIED ITEM: Architect has reviewed the submittal for general conformance to the design concept and Construction Documents and has determined that a specific item needs to be submitted and reviewed before the submittal can be released for use.
 6. FOR REFERENCE ONLY: Informational Submittal that the Architect will be reviewed but not return, unless the information does not conform with the requirements of the Construction Documents.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. 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 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection 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. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner or authorities having jurisdiction are not limited by provisions of this Section.
 - 3. Specific test and inspection requirements are not specified in this Section.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of (5) 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.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. 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, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and 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 constructed on-site as indicated in-place portions of permanent construction, consisting of multiple products, assemblies, and subassemblies, with cutaways enabling inspection of concealed portions of the Work.
 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.
 3. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 4. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. 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. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall have the same meaning as testing agency.
- I. 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.
- J. 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. Contractor's quality-control services do not include contract administration activities performed by Architect.
- 1.3 DELEGATED-DESIGN SERVICES
- 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 Services Statement: Submit 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, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

- C. Delegated-Design Qualifications: All delegated-design services provided by companies or organizations shall be performed in compliance with the Provisions listed in the document U.S. Department Of Commerce Economic Development Administration EDA Contracting Provisions for Construction Projects included in whole within the Project Manual. Companies or organizations providing delegated-design services shall not be debarred, suspended, ineligible or voluntarily excluded as defined in Provision 27 of this document. The Contractor shall be ultimately responsible to verify compliance with these Provisions prior to bid.

1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification 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. Mockup Shop Drawings: For integrated exterior mockups.
 - 1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
 - 2. Indicate manufacturer and model number of individual components.
 - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

- B. 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.
- C. Permits, Licenses, and Certificates: For Owner's record, 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.

1.7 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, telephone number, and email address 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 inspection.
 - 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 reinspecting.
- 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. Statement on condition of substrates and their acceptability for installation of product.
 - 2. Statement that products at Project site comply with requirements.
 - 3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 5. 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. Statement that equipment complies with requirements.
 - 2. Results of operational and other tests and a statement of whether observed performance complies with requirements.

3. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

- A. 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. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- 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, applying, 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 and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- 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. 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. Build mockups of size indicated.
2. Build mockups in location indicated in the Contract Documents, and as directed by Architect.
3. Notify Architect (7) seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.

a. Allow (7) seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

J. Integrated Exterior Mockups: Construct integrated exterior mockup as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.

1. Coordinate construction of the mockup to allow observation of air barrier installation, flashings, air barrier integration with fenestration systems, and other portions of the building air/moisture barrier and drainage assemblies, prior to installation of veneer, cladding elements, and other components that will obscure the work.

1.9 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 inspection they are engaged to perform.
2. 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, whether specified or not, to verify and document that the Work complies with requirements.

1. Engage a qualified testing agency to perform quality-control services.

- a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Notify testing agencies at least (24) twenty-four hours in advance of time when Work that requires testing or inspection will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when so directed.
- C. 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.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations 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 duties of Contractor.
- E. 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 Section 013300 "Submittal Procedures."
- F. 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 preinstallation 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.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives 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 inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections in the contract Documents, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect 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 copy to Contractor and authorities having jurisdiction if specifically requested by them.
 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 reference during normal working hours.

- 1. Maintain log by uploading to web-based project management software.
 - 2. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, 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 Section 017300 "Execution."
- B. Protect construction exposed by or for quality control service activities.
- C. Repair and protection are the Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

- A. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- B. Moisture-and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.
- C. Dust- and HVAC-Control Plan: If required, submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste-handling procedures.
 - 5. Other dust-control measures.

1.4 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to 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.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Common-Use Field Office (If Applicable to this project): Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
- B. Sanitary Facilities: Provide temporary toilets and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 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.

3.3 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. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. 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. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- D. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

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. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for 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. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. 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; and comparable products.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

- A. Products: Items obtained 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. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process 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. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days 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 seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Architect's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. 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 determine compliance with the Contract Documents and to determine 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. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 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: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for 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 indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, 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. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless submitted in compliance with Section 012500 Substitution Procedures.
 - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
 - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless submitted in compliance with Section 012500 Substitution Procedures.
 - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated 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 requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 2. Evidence that proposed product provides specified warranty.
 3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 4. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for limits on use of Project site.
 - 2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.2 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. 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.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or 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.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction 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.

- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching 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 provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: 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, mechanical and electrical systems, 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; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, 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. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

- C. 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 caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

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.

3.4 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.
- 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. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 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.
- I. 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.
- J. Remove and replace damaged, defective, or non-conforming Work.

3.5 CUTTING AND PATCHING

- A. Cutting and Patching, 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. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. 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.

- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. 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 minimize interruption to occupied areas.
- G. 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 neatly to minimum 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 and 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 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.
- H. 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 practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical 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 minimize evidence of patching and refinishing.
 - 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.
 - 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 and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. 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 waste materials more than seven days during normal weather or three 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.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- 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: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."
- 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 ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.8 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. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at final completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 5. Submit testing, adjusting, and balancing records.
 6. Submit sustainable design submittals not previously submitted.
 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Complete startup and testing of systems and equipment.
 3. Perform preventive maintenance on equipment used prior to Substantial Completion.
 4. Participate with Owner in conducting inspection and walkthrough with local emergency responders if required by the Authority Having Jurisdiction.
 5. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 6. Complete final cleaning requirements.
 7. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. 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.

1.5 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. 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.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization 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.
 2. Organize items applying to each space by major element, including categories for different types of work.
 3. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated file.

1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
1. Submit on digital media acceptable to Architect.
- D. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
- E. 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: Perform 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 designated portion of Project:
 - a. If applicable, 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. 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.
 - c. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - d. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - e. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - f. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations, before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
 - 2. Submit two paper copies. Architect will return zero copies.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 10 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Manual MUST be digitally searchable. Use electronic files prepared by manufacturer. Scanning of paper documents is discouraged but if necessary then configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file and to be digitally searchable.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-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.
 - 2. 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.

1.4 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
- B. 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. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.

8. Precautions against improper use.
9. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
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.

D. 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.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

1.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
- B. 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 warranties and bonds, as described below.
- C. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 1. Standard maintenance instructions and bulletins; 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.

- a. 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.
 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 video recording, 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.
- 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. 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.
- H. 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.
- 1.6 PRODUCT MAINTENANCE MANUALS
- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. 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.

- 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record ("As-Built") Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
- B. Record Specifications: Submit one paper copy or annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy or annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 RECORD ("AS-BUILT") DRAWINGS

- A. Record ("As-Built") Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Record data as soon as possible after obtaining it.
 - c. Record and check the markup before enclosing concealed installations.
 2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
 5. Submittal of As-built information that is incomplete, illegible, poorly organized or information that is submitted on damaged, torn, smudged or unreadable copy will be rejected with a request to resubmit.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT AS-BUILT DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT AS-BUILT DRAWINGS."
 - d. Name of Architect and Construction Manager.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. Note related Change Orders and record Drawings where applicable.
 - 5. Submittal of As-built information that is incomplete, illegible, poorly organized or information that is submitted on damaged, torn, smudged or unreadable copy will be rejected with a request to resubmit.
- B. Format: Submit record Specifications as annotated PDF electronic file.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's and Construction Manager's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objectives and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit (2) two copies within (7) seven days of end of each training module.
 - 1. At completion of training, submit complete training manual(s) for Owner's use prepared in same format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

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 Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- 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 have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- 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 as applicable to the system, equipment, or component:
 - 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 has 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. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. 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.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.8 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.
- 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 (7) seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral performance-based test.
- F. 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.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objectives and lessons outline.

- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of (8) eight megapixels and capable of recording in full HD mode.
 - 1. Submit video recordings on thumb drive and by uploading to web-based Project software site.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
- E. Pre-produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Salvage of existing items to be reused or recycled.

1.2 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of selective demolition activities with starting and ending dates for each activity.
- C. Predemolition photographs or video.

1.5 CLOSEOUT SUBMITTALS

- A. Inventory of items that have been removed and salvaged.

1.6 FIELD 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.

- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before selective demolition, Owner will remove the following items:
 - a. Furniture, musical instruments, and stored items.
- 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 before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner 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.
- G. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off 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 utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Temporary Shoring: Design, 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.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION

- 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. 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. Temporarily cover openings to remain.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. 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 portable fire-suppression devices during flame-cutting operations.
 - 4. Maintain fire watch during and for at least 1 hours after flame-cutting operations.
 - 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 6. Dispose of demolished items and materials promptly.
- B. 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.
- 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.
 - 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.

3.6 PATCHING

- A. Construction remaining after cutting/demolition that is exposed to view should be patched and finished neatly to match existing adjacent construction.
1. Cut CMU should be grouted to a smooth finish and painted.
 2. Exposed studs should be covered with gypsum board, mudded to blend in and painted.
 3. Trim work may be applied to cover gaps.

3.7 CLEANING

- A. Remove demolition waste materials from Project site.
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.
- B. Burning: Do not burn demolished materials.
- C. 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

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data concrete mix designs and submittals required by ACI 301.
- B. Ready-Mixed Concrete Producer Qualifications: ASTM C 94/C 94M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ACI 301, "Specification for Structural Concrete," and with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

2.2 MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain Steel Wire: ASTM A 82, as drawn.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, as drawn, flat sheet.
- D. Portland Cement: ASTM C 150, Type I or II.
- E. Fly Ash: ASTM C 618, Class C or F.
- F. Aggregates: ASTM C 33, Class 1N coarse aggregate or better, graded, with at least 10 years' satisfactory service in similar applications.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
- G. Air-Entraining Admixture: ASTM C 260.
- H. Chemical Admixtures: ASTM C 494, water reducing and water reducing and accelerating. Do not use calcium chloride or admixtures containing calcium chloride.
- I. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; maximum permeance of 0.01 as measured according to ASTM E96/E96M; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.

1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder.
- J. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
 1. Where slabs are to receive moisture sensitive flooring or adhesively applied flooring or roofing, provide curing materials and methods that will not inhibit adhesion of floor and roof coverings and will prevent failures resulting from moisture and/or alkalinity from emanating from the concrete.
- K. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.3 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301.
- B. Normal-Weight Concrete:
 1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: Maintain within range permitted by ACI 301. Do not allow air content of floor slabs to receive troweled finishes to exceed 3 percent.
 5. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M.
 1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 CONCRETING

- A. Construct formwork according to ACI 301 and maintain tolerances and surface irregularities within ACI 347R limits of Class A, 1/8 inch for concrete exposed to view and Class B, 1/4 inch for other concrete surfaces.
- B. Place vapor retarder on prepared subgrade, with joints lapped 6 inches and sealed.
- C. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- D. Install construction, isolation, and contraction joints where needed. Install full-depth joint-filler strips at isolation joints.

- E. Dowel new slabs into existing slabs to prevent differential settlement.
- F. Match rebar that is in the existing slab for the new.
- G. Place concrete in a continuous operation and consolidate using mechanical vibrating equipment.
- H. Protect concrete from physical damage, premature drying, and reduced strength due to hot or cold weather during mixing, placing, and curing.
- I. Slab Finishes: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces. Provide the following finishes:
 - 1. Scratch finish for surfaces to receive mortar setting beds.
 - 2. Float finish for surfaces to receive waterproofing, roofing, or other direct-applied material.
 - 3. Troweled finish for floor surfaces and floors to receive floor coverings, paint, or other thin film-finish coatings.
 - 4. Trowel and fine-broom finish for surfaces to receive thin-set tile.
- J. Cure formed surfaces by moisture curing for at least seven days.
- K. Begin curing concrete slabs after finishing. Keep concrete continuously moist for at least seven days.
- L. Protect concrete from damage. Repair and patch defective areas.

END OF SECTION 033000

SECTION 033543 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polished concrete finishing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advanced Floor Products.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Laticrete International, Inc.
 - d. MAPEI Corporation.
 - e. Or approved equal

PART 3 - EXECUTION

3.1 POLISHING

A. Polish:

1. Medium deep Grind – Level 3: Satin sheen, 400 grit
 - a. Aggregate exposure – Class C – medium aggregate finish.
 - b. Stain color to be applied to surface after grind complete.
 - 1) Color – to be selected from manufacturers standard options.

B. Apply polished concrete finish system to cured and prepared slabs.

1. Machine grind floor surfaces to receive polished finishes level and smooth.

2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
3. Apply penetrating stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
4. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
5. Control and dispose of waste products produced by grinding and polishing operations.
6. Neutralize and clean polished floor surfaces.

END OF SECTION 033543

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Plastic-laminate countertops
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.

C. Samples: For each exposed product and for each color and texture specified.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: 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.

B. Installer Qualifications: Manufacturer of products.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET FABRICATORS

A. Fabricators: Subject to compliance with requirements, provide products by one of the following:

1. Egli Bros.
2. LSI Corporation
3. Modern Cabinet
4. Sidney Millwork Company
5. TMI Storage Systems Corp.

6. Johnson Brothers.
7. JBD Cabinets.
8. Pyramid Cabinet Shop.
9. Pre-approved equal

2.2 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
- B. Architectural Woodwork Standards Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
- F. Laminate Cladding for Exposed Surfaces:
 1. Horizontal Surfaces: Grade HGS.
 2. Postformed Surfaces: Grade HGP.
 3. Vertical Surfaces: Grade VGS.
 4. Edges: Grade HGS, PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
 5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- I. 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 indicated by laminate manufacturer's designations.
 - a. **Formica – Earth Wash Matte Finish 7213-58**

2.3 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate countertops indicated for construction, finishes, installation, and other requirements.
- B. Grade: Custom.
- C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
 - 1. Grade: HGS
- D. Grain Direction: Parallel to cabinet fronts.
- E. Edge Treatment: Gem-loc edges
 - a. Loti Corporation: TG Style Gem-Loc or equal.
- F. 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 indicated by laminate manufacturer's designations.
 - a. **Color TBD**

2.4 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

2.5 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural.
- B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening, self-closing
- C. Decorative Pulls: Back mounted, solid metal, 4 to 5 inches long. To be selected by architect from average cost range (provide selection options).
- D. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.
- E. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.

- F. Shelf Rests: BHMA A156.9, B04013; metal.
- G. Drawer Slides: BHMA A156.9.
 - 1. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-overtravel-extension type; zinc-plated-steel ball-bearing slides.
- H. Door Locks: ANSI/BHMA A156.11, E07121.
- I. Drawer Locks: ANSI/BHMA A156.11, E07041.
- J. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- K. Heavy Duty Cabinet Cleats: Aluminum Z-Clip, High load capacity
 - 1. Monarch Metal Inc – MFSTR-050
- L. Under Counter Supports:
 - 1. Counters up to 24" Deep: Rakks; EH-1818
 - 2. Counters up to 30" deep: Rakks; EH1824
 - 3. Color: Paint to match wall.
- M. Grommets for Cable Passage: 1-1/4-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Color: to be selected by architect from manufacturers full range.
- N. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
 - 1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base.
- O. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood 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 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.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement, Contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.7 FABRICATION

- A. Complete fabrication, including assembly 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.
- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, 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 INSTALLATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings 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.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.
- E. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
 - 3. Caulk space between backsplash and wall with clear silicone sealant.

3.2 ADJUSTING AND CLEANING

- A. Repair damaged and defective work, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery, doors and drawers for uniform appearance.
- B. Clean, lubricate and adjust hardware.

END OF SECTION 064116

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes plastic sheet paneling.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling and trim accessories.

1.3 QUALITY ASSURANCE

- A. Testing Agency: Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Composites, Inc.
 - b. Glasteel.
 - c. Nudo Products, Inc.
 - d. Pre-approved equal.
 - 2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 3. Nominal Thickness: Not less than 0.09 inch.
 - 4. Surface Finish: Molded pebble texture.
 - 5. Color: White.

2.2 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, and caps as needed to conceal edges.
 - 1. Color: White.
- B. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- C. Lay out paneling before installing.

3.2 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive. Do not fasten through panels.
- D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

3.3 SCHEDULE

- A. Install plastic paneling behind and beside washer, dryer to 4' high.

END OF SECTION 066400

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Latex joint sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples: For each kind and color of joint sealant required.
- C. 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.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.4 WARRANTY

- A. Special Installer's Warranty: 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 agrees to furnish joint sealants to repair or replace those joint sealants 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.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:
 - 1. Architectural sealants shall have a VOC content of 250 g/L or less.
 - 2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
 - 3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Dow Corning Corporation; 795, 888.
 - b. GE Construction Sealants; SilPruf NB.
 - c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 295 FPS NB.
 - d. Pecora Corporation; 895NST.
 - e. Tremco Incorporated; Spectrem 3.
 - f. Pre-approved equal.

2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. BASF Construction Chemicals, LLC, Building Systems; Sonolastic SL 1.
 - b. Pecora Corporation; NR-201.
 - c. Polymeric Systems, Inc.; Flexiprene 952.
 - d. Sherwin-Williams Company (The); Stampede 1SL.
 - e. Pre-approved equal.

2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Dow Corning Corporation; 786-M White.
 - b. GE Construction Sealants; SCS1700 Sanitary.
 - c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 100 WF.
 - d. Tremco Incorporated; Tremsil 200.
 - e. Pre-approved equal.

2.5 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. BASF Construction Chemicals, LLC, Building Systems; Sonolac.
 - b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex 600.
 - c. Pecora Corporation; AC-20.
 - d. Sherwin-Williams Company (The); 850A.
 - e. Tremco Incorporated; Tremflex 834.
 - f. Pre-approved equal.

2.6 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bi-cellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. BASF Construction Chemicals, LLC, Building Systems.
 - b. Construction Foam Products, a division of Nomaco, Inc.
 - c. Pre-approved equal .
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

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.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 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 laitance and form-release agents from concrete.
 - 2. 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.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. 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.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- 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 to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 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. Other joints as indicated on Drawings.
2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors, windows.
 - c. Other joints as indicated on Drawings.
2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

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:
 - 1. Interior standard steel frames.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- C. Product Schedule: For hollow-metal doors and frames, 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.

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. Ceco Door; ASSA ABLOY.
 - 2. Curries Company; ASSA ABLOY.
 - 3. MPI Group, LLC (The).
 - 4. North American Door Corp.
 - 5. Premier Products, Inc.
 - 6. Republic Doors and Frames.
 - 7. Rocky Mountain Metals, Inc.
 - 8. Security Metal Products; a brand of ASSA ABLOY.
 - 9. Steelcraft; an Allegion brand.
 - 10. West Central Manufacturing, Inc.

2.2 INTERIOR STANDARD STEEL FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Drawings.
 - 1. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Construction: Full profile welded.

2.3 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor.
 - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.4 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 A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- E. 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.
- F. Mineral-Fiber Insulation: ASTM C665, 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 E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.5 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. 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. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/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 BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.6 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 ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 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. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Solidly pack mineral-fiber insulation inside frames.
 - 4. Installation Tolerances: Adjust hollow-metal frames 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.

3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 REPAIR

- A. 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.
- B. 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 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 Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of door. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples: For factory-finished doors.

1.3 QUALITY ASSURANCE

A. Quality Standard: WDMA 1.S.1-A

B. Fire-Rated Wood Doors: Labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing per NFPA 252.

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. Eggers Industries.
 - 3. Graham Wood Doors; ASSA ABLOY Group company.
 - 4. Lynden Door
 - 5. Summit Door Inc
 - 6. VT Industries
- B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
- B. WDMA I.S.1-A Performance Grade:
 - 1. Heavy Duty unless otherwise indicated.
- C. 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.
 - 1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - 3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- D. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2, made with binder containing no urea-formaldehyde.
 - 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - 3. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- E. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

- a. Screw Withdrawal, Face: 700 lbf.
- b. Screw Withdrawal, Edge: 400 lbf.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

- 1. Grade: Premium, with Grade A faces.
- 2. Species: Select red oak – match existing.
- 3. Cut: Rotary cut.
- 4. Match between Veneer Leaves: Book match.
- 5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
- 6. Core: Cross-banded Particleboard or Structural composite lumber. Provide blocking in particleboard cores or provide structural composite lumber cores instead of particleboard cores for doors with exit devices or protection plates.
- 7. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.

2.4 LIGHT FRAMES AND LOUVERS

- A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated on Drawings.

2.5 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 NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
- C. Openings: Factory cut and trim openings through doors.
 - 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 Section 088000 "Glazing."

2.6 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. Factory finish doors that are indicated to receive transparent finish.
- C. Transparent Finish:
 1. Grade: Premium.
 2. Finish: WDMA TR-4 conversion varnish or WDMA TR-6 catalyzed polyurethane.
 3. Staining: As selected by Architect from manufacturer's full range matching the stain of the doors in Phase 1 construction in the north and south portions of the building.
 4. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.
 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware" and comply with manufacturer's templating and mortising instructions.
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 1. Install fire-rated doors according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 081416

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:
 - a. Swinging doors.

1.2 PREINSTALLATION MEETINGS

- A. Keying Conference: Conduct conference at via conference call with Owner and Architect.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Door hardware schedule.
- C. Keying schedule.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
- B. Architectural Hardware Consultant Qualifications: A person 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 and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
 - a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is 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 10C.
- B. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- C. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design".

2.2 SCHEDULED DOOR HARDWARE

- A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
 - 1. Door hardware is scheduled in Part 3. Basis of Design using Manufacturer's actual products are scheduled. Products of other approved manufacturers are allowed.

2.3 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

D. Lock Trim:

1. Description: Indicator escutcheon.
2. Levers: Brushed Stainless
3. Escutcheons (Roses): Brushed Stainless

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Schlage - Allegion plc.

2.4 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Schlage - Allegion plc (NO EXCEPTIONS)
- 2.

B. High-Security Lock Cylinders: BHMA A156.30; Grade 1 permanent cores that are removable; face finished to match lockset.

1. Type: M, mechanical; Schlage Everest 29 R Small Format Interchangeable Core

C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.5 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock.

1. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.

B. Keys: Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."

2.6 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
- B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:
 1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
 2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
 3. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

2.7 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
- C. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 1. Replace construction cores with permanent cores as directed by Owner.

3.2 ADJUSTING

- A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.3 DOOR HARDWARE SCHEDULE

Hardware Set 1:

- 3 Hager 4.5x4.5 BB1191-NRPx626 commercial duty hinges.
- 1 Schlage L9070x626 Classroom Lockset
- 1 Hager 232W US26D Wall bumper
- 1 LCN 4041 Door Closer
- 1 Hager 12-inch high by 34-inch wide Stainless Steel kick plate on push side of door.
- 1 Pemco S88 Sound seal
- 1 Key Core – match school's existing standard.

Hardware Set 2:

- 3 Hager 4.5x4.5 BB1191-NRPx626 commercial duty hinges.
- 1 Schlage L9050x626 Entrance Lockset
- 1 Hager 232W US26D Wall or 241F Floor bumper.
- 1 Hager 12-inch high by 34-inch wide Stainless Steel kick plate on push side of door.
- 1 Key Core– match school's existing standard.

Hardware Set 3:

- 3 Hager 4.5x4.5 BB1191-NRPx626 commercial duty hinges.
- 1 Schlage ND10x626 Passage Lockset
- 1 Hager 232W US26D Wall bumper.
- 1 Hager 12-inch high by 34-inch wide Stainless Steel kick plate on push side of door.
- 1 Pemco S88 Sound seal
- 1 Schlage LB664Px626 Cylinder only Deadbolt.
- 1 Key Core– match school's existing standard.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass for doors, interior borrowed lites.
2. Glazing sealants and accessories.

1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AGC Glass Company North America, Inc.
 2. Cardinal Glass Industries.
 3. Guardian Glass; SunGuard.
 4. Oldcastle BuildingEnvelope™.
 5. Pilkington North America.
 6. Viracon, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Glazing Manual."
 - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing 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.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

- D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.5 ACOUSTIC GLAZING SEAL

- A. Neoprene Acoustic Tapes: Neoprene rubber seal; factory coated with adhesive on back surface; and complying with AAMA 800.
 - 1. Install on both sides of glass.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Acoustic Setting Blocks:
 - 1. Neoprene setting block –1/4” x 3/8” .
 - 2. Type recommended by sealant or glass manufacturer.
- C. Edge Blocks:
 - 1. EPDM with a Shore A durometer hardness per manufacturer's written instructions.
 - 2. Type recommended by sealant or glass manufacturer.

PART 3 - EXECUTION

3.1 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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. 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 acoustic sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

- F. 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.

3.2 ACOUSTIC TAPE GLAZING

- A. Position acoustic gaskets on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Acoustic seal tape to be placed on both sides of glass.
- E. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on acoustic setting blocks, and press against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric acoustic sealant over exposed edge of tape.

3.3 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations.
- C. Remove and replace glass that is damaged during construction period.

3.4 MONOLITHIC GLASS SCHEDULE

- A. Glass Type : Clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Actual Thickness: 0.0329 inch. Equivalent thicknesses are not acceptable.
2. Depth: As indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide one of the following in thickness not less than indicated for studs and in width to accommodate depth of studs:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.

a. Products: Subject to compliance with requirements, provide the following:

- 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
- 2) MBA Building Supplies; FlatSteel Deflection Track.
- 3) Steel Network Inc. (The); VertiClip SLD Series.
- 4) Superior Metal Trim; Superior Flex Track System (SFT).
- 5) Telling Industries; Vertical Slip Track.
- 6) Pre-approved equal.

2.2 FASTENERS

- A. General: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Fasteners for Metal Furring:
 - 1. Product: TruFast SIP LD - #14 Drill Point Screw or pre-approved equal.
 - 2. Installer is responsible to meet required lengths per manufacturer's written installation guidelines.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 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.

3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. 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. Framed Openings: Frame openings to provide metal framing members around the entire perimeter of the opening. Install framing below sills of openings to match framing required above heads.
- E. 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 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.
3. Texture finishes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Gypsum LLC.
 - b. National Gypsum Company.
 - c. USG Corporation.
 - d. Or approved equal.

2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered.

B. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Thickness: 5/8 inch (12.7 mm).
2. Long Edges: Tapered.

C. Impact-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.

1. Core: 5/8 inch.
2. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
3. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
4. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
5. Hard-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements according to test in Annex A1.
6. Long Edges: Tapered.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Gypsum LLC.
 - b. National Gypsum.
 - c. USG Corporation.
 - d. Or approved equal.
2. Core: 5/8 inch (15.9 mm), Type X.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, 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 drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose 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 high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- D. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 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 C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

2.8 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
- B. Texture: As selected by architect from mockup panels - Orange Peel

PART 3 - EXECUTION

3.1 INSTALLATION AND FINISHING OF PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C840.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. 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.
- D. 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.
- E. Use impact resistant gypsum board in Gymnasium, Weight room to 8' and Café, Heart, hallways and commons areas to 4' unless otherwise indicated on plans.
- F. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- G. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- H. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 3: Panels that are substrate for FRP.
 - 4. Level 4: At all panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- I. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- J. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.2 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching adjacent existing walls, free of starved spots or other evidence of thin application or of application patterns.

3.3 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.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceramic Glazed wall tile.
 - 2. Metal edge strips.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples:
 - 1. 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- 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.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer has preformed no less than 10 projects of similar size and complexity.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics 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 TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

- A. Ceramic Tile Type: Glazed Wall Tile: <CT1> <CT2>
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Daltile.
 - 2. Module Size: 3 by 6 inches
 - 3. Face Size Variation: Rectified.
 - 4. Thickness: 5/16 inch (7.90 mm).
 - 5. Face: Plain with modified square edges.
 - 6. Finish: Semi-Gloss
 - 7. Tile Color and Pattern: Match Architect's sample
 - a. Field: Biscuit K175 <CT1>
 - b. Field: Artisan Brown 0144 <CT2>
 - c. Pattern: staggered brick joint – see elevations for color layout.
 - 8. Grout Color: Off-White to match tile.
 - 9. 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. Bullnose: module size 3 by 6 inches, at tops and sides where not ending at wall corner or cabinet/counter.

2.3 SETTING MATERIALS

- A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
 - 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. Bonsal American, an Oldcastle company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. LATICRETE SUPERCAP, LLC.
 - e. MAPEI Corporation.
 - f. Pre-approved equal
2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
3. For wall applications, provide nonsagging mortar.

2.4 GROUT MATERIALS

- A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik, Inc.
 - b. C-Cure.
 - c. LATICRETE SUPERCAP, LLC.
 - d. MAPEI Corporation.
 - e. Pre-approved equal

2.5 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials 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 the Work.
 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CERAMIC TILE INSTALLATION

- A. 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.
- B. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- C. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. 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.
- D. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Glazed Wall Tile: 1/16 inch
- E. 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. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- F. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- G. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.3 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. Ceramic Tile Installation Walls: TCNA B419; thinset mortar on gypsum board.
 - a. Ceramic Tile Type: all
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.
- B. Diffusing panels in exposed suspension system.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For seismic restraints for ceiling systems. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E1264.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS (APC)

- A. Basis of Design: Subject to compliance with requirements, provide Armstrong Ultima High NRC or comparable products by one of the following:
 - 1. Armstrong Ceiling & Wall Solutions.
 - 2. Certainteed; SAINT-GOBAIN.
 - 3. USG Corporation.
- B. Acoustical Panel Standard: Manufacturer's standard panels according to ASTM E1264.
- C. Classification: Type IV, Form 2, and Pattern E.
- D. Color: White.
- E. Light Reflectance (LR): 0.85
- F. Ceiling Attenuation Class (CAC): 35.
- G. Noise Reduction Coefficient (NRC): 0.75
- H. Edge/Joint Detail: Square.
- I. Thickness: 3/4 inch.
- J. Modular Size: 24 by 48 inches.
- K. Finished Surface: Mold/Mildew Inhibitor

2.3 ACOUSTICAL PANELS - KITCHEN (APCV)

- A. Basis of Design: Subject to compliance with requirements, provide Armstrong World Industries, Inc., Clean Room VL /Perforated or comparable products by one of the following:
 - 1. Armstrong Ceiling & Wall Solutions.
 - 2. Certainteed; SAINT-GOBAIN.
 - 3. USG Corporation.
- B. Acoustical Panel Standard: Manufacturer's standard panels according to ASTM E 1264.
- C. Classification: Type III, wet formed mineral fiber
- D. Color: White.
- E. Light Reflectance (LR): 0.78.
- F. Ceiling Attenuation Class (CAC): Not less than 35.
- G. Noise Reduction Coefficient (NRC): 0.55.
- H. Edge/Joint Detail: Square.
- I. Thickness: 5/8 inch.
- J. Modular Size: 24 by 48 inches.
- K. Performance: Anti-mold, Humidity/Sag resistance

2.4 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong Ceiling & Wall Solutions.
 - 2. Certainteed; SAINT-GOBAIN.
 - 3. USG Corporation.

- B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.
 - 1. Structural Classification: Heavy-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Cold-rolled steel or aluminum.
 - 5. Cap Finish: Painted white.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Same manufacturer as suspension system.
- 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.

PART 3 - EXECUTION

3.1 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 unless otherwise indicated.
- B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
- B. 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. Do not use exposed fasteners, including pop rivets, on moldings and trim.
3. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermoplastic-rubber base.
 - 2. Rubber molding accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE <RB>

- A. Basis of Design: Use Shaw Traditional Wall Base
- B. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).
 - 1. Group: I (solid, homogeneous).
 - 2. Style and Location:
 - a. Style B, Cove
- C. Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: Earthen - 00770

2.2 RUBBER MOLDING ACCESSORY

- A. Provide rubber molding accessories from same manufacturer as rubber base.

- B. Description: transition strips.
- C. Locations: Provide rubber molding accessories in areas indicated above.
- D. Colors and Patterns: Match Architect's sample.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 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 practical 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 and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or Cope corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient Vinyl Tile Plank

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: Full-size units of each color and pattern of floor tile required.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.4 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. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

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 or more than 85 deg F.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 85 deg F, in spaces to receive resilient products.
- B. Install resilient products after other finishing operations, including painting, have been completed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 ENHANCED RESILIENT TILE <LVT>

- A. Basis of Design Product: Subject to compliance with requirements, provide Mannington Spacia Collection -Wood: Mulled Oak-SS5W3313.
- B. Tile Standard: ASTM F1700.
 - 1. Class: Class III
 - 2. Type: B
- C. Thickness: 0.157 inch (4 mm)
- D. Size: 7.25 by 48 inches (184 by 1219 mm)
- E. Colors and Patterns:
 - 1. Color: Mulled Oak-SS5W3313
 - 2. Pattern: Stagger

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Flooring also to be clicked and locked into place, install method is glue down .

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 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 floor tile manufacturer. Do not use solvents.
- C. Alkalinity, Adhesion and Moisture Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after tests fall within recommended levels by manufacturer in writing.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 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.
- 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 in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- 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 marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to 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.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
- B. Section includes surface preparation and the application of paint systems on **interior substrates**.
 - 1. Steel and iron.
 - 2. Galvanized metal.
 - 3. Gypsum board.

1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Sherwin-Williams Company
2. Benjamin Moore
3. Behr
4. Approved Equal

- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

- B. Colors: Match Architect's samples in Finish Schedule.

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 the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
 2. Fiber-Cement Board: 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. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and 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.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. 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.

3.4 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
 - 1. High-Performance Architectural Latex System, MPI INT 5.1R:
 - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
 - 1) SW – Kem Bond HS Universal Alkyd Primer.
 - 2) Approved equal.
 - b. Prime Coat: Shop primer specified in Section where substrate is specified.
 - c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - d. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.
 - 1) SW – ProMar 200 Acrylic Latex – Semi-Gloss
 - 2) Approved equal.
- B. Gypsum Board Substrates:
 - 1. Latex System: High-Performance Architectural Latex System MPI INT 9.2B:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.

- 1) SW - ProMar 200 Zero
 - 2) Approved equal.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.
 - 1) SW - ProMar 200 HP Zero VOC - EgShel
2. Water-Base Epoxy System: High-Performance Architectural Latex System MPI INT 9.2B:
 - a. Location – Restrooms
 - b. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - 1) SW - ProMar 200 Zero
 - 2) Approved equal.
 - c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.
 - 1) SW – Prod-Industrial Pre-Catalyzed Waterbased Epoxy – EgShel

3.5 PAINT COLOR SCHEDULE

- A. PT1 – Sherwin Williams – Crème SW 7556
 1. Location – main color
- B. PT2 – Sherwin Williams – Interactive Cream SW 6113
 1. Location – accent at teaching walls
- C. PT3 – Sherwin Williams – Nearly Brown SW 9093
- D. PT4 – Sherwin Williams – Raisin SW 7630
 1. Location - Columns

END OF SECTION 099123

SECTION 101100 - VISUAL DISPLAY 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. Section Includes:
 - 1. Markerboards
 - 2. Tackboards

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
- B. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color finishes, and as follows:
 - 1. Samples of facings for each visual display panel type, indicating color and texture.
- C. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units 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 units by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.6 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: 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: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

2.2 MARKERBOARDS

- A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish.
 - 1. **WB** - Wenger - Porcelain steel markerboard at locations, sizes and details per Drawing elevations.
 - 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
 - 3. Frame color: Silver

2.3 TACKBOARDS (TB)

- A. Visual Display Board Assembly: factory fabricated.
 - 1. Assembly: tackboard.
 - 2. Corners: Square.
- B. Tackboard Panels:

1. Facing: 1/4-inch- thick, plastic-impregnated cork.
 2. Core: Manufacturer's standard.
- C. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; standard size and shape of size and shape indicated on Schedule.
1. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
 2. Aluminum Finish: Clear anodic finish.

2.4 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
- C. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.
- D. Hardboard: ANSI A135.4, tempered.
- E. Extruded Aluminum: ASTM B 221, Alloy 6063.
- F. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
- G. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Section 099123 "Interior Painting" and recommended in writing by visual display unit manufacturer for intended substrate.

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. 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 unacceptable. 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 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 motorized, sliding visual display units.
- C. Examine walls and partitions for proper preparation and backing for visual display units.
- 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.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- 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 units and wall surfaces.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
 - 1. Locations for markerboards and tackboards indicated in the schedule will be coordinated with the architect and owner prior to installation.
 - 2. Heights: Mount top of boards at 7' except PB, which will be 8'

3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

3.5 BULLETIN/MARKERBOARD/ SCHEDULE

- A. Teaching Wall in each 2 classrooms: Provide 2x WB (48"x60"),
- B. Other Wall in each 2 classrooms: Provide 1x TB (48"x48")

END OF SECTION 101100

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification 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 other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

- 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. APCO Graphics, Inc.
2. InPro Corporation (IPC).
3. Take Form.
4. Or approved equal.

- B. Panel Sign System: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic or phenolic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
 - b. Surface-Applied Graphics: Applied vinyl film.
2. Engraved Plastic-Laminate Sign: Plastic-laminate face laminated to contrasting phenolic core to produce composite sheet.
 - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
 - b. Engraved Graphics: Characters engraved through plastic-laminate face sheet to expose contrasting phenolic core.
 - c. Plastic-Laminate Color and Pattern: As selected by Architect from manufacturer's full range.
 - d. Core Color: Manufacturer's standard dark color.
3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Square.
4. Frame: To hold changeable sign panel.
 - a. Material: Aluminum.
 - b. Material Thickness: Manufacturer's standard.
 - c. Frame Depth: As indicated.
 - d. Profile: Square.
 - e. Corner Condition in Elevation: Square.
 - f. Finish and Color: As selected by Architect from manufacturer's full range.

5. Mounting: Surface mounted to wall with concealed anchors.
6. Surface Finish and Applied Graphics:
 - a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
 - b. Integral Acrylic or Fiberglass Sheet Color: As selected by Architect from full range of industry colors.
 - c. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
 - d. Overcoat: Manufacturer's standard baked-on clear coating.
7. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.
8. Flatness Tolerance: Sign panel shall remain flat or uniformly curved under installed conditions as indicated and within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner.
9. See drawings sheet A932 for sizes, layout configurations and locations.

2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Photopolymer Sheet: ASTM D 1929.
 1. Signage shall comply with all applicable provisions of the ADA and ANSI A117.1-1998.
 2. Fire Performance Characteristics: Provide photopolymer signage with surface burning characteristics that consist of a flame spread of 75 and a smoke development of 120 when tested in accordance to UL 723 (ASTM E-84).
 3. Self-Extinguishing: Provide photopolymer signage with a CC1 classification for 0.060 inch thick material, when tested in accordance with the procedures in ASTM D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning Plastics in a horizontal position.
 4. Vertical Burn: Provide photopolymer material that is classified as 94V-2 for material 0.118 inch thick or greater and 94HB for material 0.118 inch thick or less when tested in accordance with UL94, tests for flammability of plastic materials for parts in devices and appliances.
 5. Self-Ignition Temperature: Provide photopolymer material that has a self-ignition temperature of 800 deg F when tested in accordance with ASTM D1929, Standard Test Method for determining ignition temperature of plastics

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.
 - 3. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.

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.
- B. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
 - 1. 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.

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.

2.7 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, Class II, 0.010 mm or thicker.

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 anchor inserts are correctly sized and located to accommodate signs.
- C. 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.
- B. Room-Identification Sign 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.
- D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

END OF SECTION 101423.16

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fire-protection cabinets for portable fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 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.

2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated below or comparable product by one of the following:
 - a. Larsens Manufacturing Company.
 - 1) Model 2409-R4 Semi-Recessed cabinets for fire extinguishers.
 - b. Fire-End & Croker Corporation.
 - c. Guardian Fire Equipment, Inc.
 - d. JL Industries, Inc.; a division of the Activar Construction Products Group.

- e. Nystrom, Inc.
 - f. Potter Roemer LLC.
 - g. Strike First Corporation of America.
 - h. Pre-approved equal.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Aluminum sheet.
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
- E. Cabinet Trim Material: Aluminum sheet.
- F. Door Material: Aluminum sheet.
- G. Door Style: Fully glazed 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.
- J. Accessories:
 - 1. 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: Pressure-sensitive vinyl letters.
 - 3) Lettering Color: Black.
 - 4) Orientation: Vertical.
- K. Materials:
 - 1. Aluminum: ASTM B 221 (ASTM B 221M), with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet. ASTM B 221 (ASTM B 221M) for extruded shapes.
 - a. Finish: Clear anodic.
 - 2. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply vinyl lettering at locations indicated.
- E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

3.2 SCHEDULE

- A. Install 1 fire extinguisher cabinet with fire extinguisher in Food Lab

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Warranty: Sample of special warranty.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.5 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: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide products below or comparable product by one of the following:
 - a. Larsens Manufacturing Company
 - 1) Multipurpose Dry Chemical Type Extinguisher, UL Rated K-80-B:C,, Model MP10
 - b. Ansul Incorporated.
 - c. Guardian Fire Equipment, Inc.
 - d. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - e. Larsens Manufacturing Company.
 - f. Nystrom Building Products.
 - g. Pem All Fire Extinguisher Corp.
 - h. Pyro-Chem; Tyco Safety Products.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: In locations not provided with fire cabinets, provide manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
 - 1. Subject to compliance with requirements, provide mounting brackets compatible with the specified fire extinguisher as recommended by fire extinguisher manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: Top of fire extinguisher to be at 52 inches (1372-mm) above finished floor.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 113013 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cooking appliances.
2. Kitchen exhaust ventilation.
3. Cleaning appliances

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that 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. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 RANGES

A. Electric Range: Freestanding or Slide-in range with one oven(s) and complying with AHAM ER-1.

1. Basis of design: GE JS760SPSS
2. Electric Burner Elements: Four radiant-type burners, smooth top
3. Oven Capacity: 6.3 Cu.Ft., convection
4. Anti-Tip Device: Manufacturer's standard.

5. Material: Fingerprint resistance Stainless Steel with manufacturer's standard smooth cooktop.
 6. Number: Provide 2
- B. Gas Range: Freestanding or Slide-in range with one oven(s) and complying with AHAM ER-1.
1. Basis of design: Samsung NE63T8511SS
 2. Electric Burner Elements: Four radiant-type burners, smooth top
 3. Oven Capacity: 6.3 Cu.Ft., convection
 4. Anti-Tip Device: Manufacturer's standard.
 5. Material: Fingerprint resistance Stainless Steel with manufacturer's standard smooth cooktop.
 6. Number: Provide 3

2.3 OVENS

- A. Electric Oven: Built-in oven (under counter and under microwave) and complying with AHAM ER-1.
1. Basis of design: GE JKS5000SNSS
 2. Cooking technology: Convection
 3. Oven Capacity: 4.3 Cu.Ft., 27" wide
 4. Anti-Tip Device: Manufacturer's standard.
 5. Material: Fingerprint resistance Stainless Steel with manufacturer's standard smooth cooktop.
 6. Number: Provide 2

2.4 COOKTOPS

- A. Electric Cooktops: Built-in cooktop and complying with AHAM ER-1.
1. Basis of design: GE PEP7030DTBB
 2. Electric Burner Elements: Four radiant-type burners, smooth top
 3. Material: Black with manufacturer's standard smooth cooktop.
 4. Number: Provide 1 (ADA station)
- B. Electric Cooktops: Built-in cooktop and complying with AHAM ER-1.
1. Basis of design: GE PEP9030STSS
 2. Electric Burner Elements: Five radiant-type burners, smooth top
 3. Material: Black with manufacturer's standard smooth cooktop.
 4. Number: Provide 1 (teacher station)

2.5 MICROWAVE OVENS

- A. Microwave Oven:
1. Basis of design: GE PEB7227ANDD
 2. Mounting: Built-in mount.
 3. Capacity: 2.2 cu. ft.
 4. Microwave Power Rating: Manufacturer's standard.

5. Material: Porcelain-enameled steel.
 6. Number: Provide 1
- B. Microwave Oven:
1. Basis of design: GE PEB9159SJSS
 2. Mounting: Counter mount.
 3. Capacity: 1.5 cu. ft.
 4. Microwave Power Rating: Manufacturer's standard.
 5. Material: Porcelain-enameled steel.
 6. Number: Provide 1
- C. Over-Range microwave Oven:
1. Basis of design: GE JVM6175YKFS
 2. Mounting: Undercabinet Wall mount.
 3. Capacity: 1.6 cu. ft.
 4. Exhaust Fan: Variable Two-speed fan, recirculating with manufacturer's standard capacity.
 5. Microwave Power Rating: Manufacturer's standard.
 6. Material: Porcelain-enameled steel.
 7. Number: Provide 5

2.6 CLOTHES WASHERS AND DRYERS

- A. Clothes Washer: Complying with AHAM HLW-1.
1. Type: Top-loading unit.
 2. Capacity: 3.8 cu. ft..
 3. Agitator: Center spindle or Impeller (without spindle).
 4. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
 5. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.
 6. Appliance Finish: Enamel.
 7. Front-Panel Finish: Manufacturer's standard.
 8. Number: Provide 1
- B. Clothes Dryer: Complying with AHAM HLD-1.
1. Type: frontloading, electric unit.
 2. Capacity: 7.0 cu. ft..
 3. Features: Interior drum light.
 4. Appliance Finish: Enamel.
 5. Front-Panel Finish: Manufacturer's standard.
 6. Number: Provide 1

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- C. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 113013

SECTION 114000 - FOODSERVICE EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes equipment for foodservice facilities indicated on the designated foodservice drawings (FS).
- B. Kitchen Equipment Contractor to coordinate/relocate owner provided and/or existing equipment when applicable.

1.2 RELATED SECTIONS / DIVISIONS

- A. Refer to General Conditions, Supplementary Conditions, and applicable provisions of Division 1 for additional instructions.
- B. Refer to Divisions 5, 6, and 9 – Interior Design;
- C. Refer to Division 22 – Plumbing;
- D. Refer to Division 23 – Heating Ventilating and Air Conditioning (HVAC);
- E. Refer to Division 26 – Electrical;
- F. Work included in other Divisions – Provision of all wall, floor, and/or ceiling/roof openings, recesses, sleeves, and/or conduits; and equipment pads, and sealing thereof, as necessary for installation of items included in this section.
- G. Work included in other Divisions – Disconnection of existing equipment to be relocated and/or reused; and removal of existing equipment which will not be reused, as determined, and designated by the Architect in other Divisions.

1.3 DEFINITIONS

- A. EXISTING – Equipment previously purchased by the owner and located on site. KEC responsible for relocating and installing equipment.
- B. FURNISH – Supply and deliver to Project Site.
- C. FUTURE – Equipment slated for future acquisition and installation. Not in KEC contract.
- D. INSTALL – Furnish and install complete; ready for final utility connections by other Divisions as appropriate.

- E. KEC – Refers to the Kitchen Equipment (Sub) Contractor in this Section. References to any other Contractor or Division will be specific; such as General contractor, Plumbing (Sub) Contractor / Division, Electrical (Sub) Contractor / Division, Architect designated, etc.
- F. NIC – Not in Kitchen Equipment Contractors (KEC) contract. May be in other contracts within project or shown for reference.
- G. BY DIV XX – Equipment in other divisions within the project, shown for reference only in foodservice drawings. Examples: BY DIV 22, BY DIV 23, BY DIV 26
- H. OSCI – Owner Supplied, Contractor (KEC) Installed - Equipment item that is purchased by the owner or currently installed at facility and will be removed and re-installed in new plan as shown/defined. Equipment is not in KEC contract, however coordinating, relocating, and setting in place is required by the Kitchen Equipment Contractor. Modifications and accessories to owner equipment as defined or shown within the documents and/or for the current operational intent of the documents will be the responsibility of the KEC. Modifications and new accessories to be coordinated by the KEC with the owner provided equipment, errors in compatibility to be noted to design team during submittal process.
- I. PROVIDE (set in place) – Operations at Project Site including unloading, assembly, placing, leveling and similar operations; ready for final utility connections by other Divisions as appropriate.

1.4 QUALIFICATIONS

- A. Kitchen Equipment Contractor's requirements:
 - 1. Engaged in direct selling and installation to final user or user's agent of equipment specified in this section.
 - 2. Established in the foodservice/commercial kitchen equipment supply business for a minimum of five (5) years continuous operation under the same company name and ownership. Documentation supporting that experience must be provided upon request.
 - 3. Financially stable and have the ability to complete this project.
 - 4. Comparable size and scope projects completed in the last five (5) years.
 - 5. Have manufacturer's authorization to purchase, distribute, and install all items specified.
 - 6. Not engaged in conflicting installations at time of completion of this project. A complete list of projects and installation dates must be provided upon request.
- B. Any sub-contractor employed by Kitchen Equipment Contractor, is to comply with the same qualifications.
- C. Kitchen Equipment Contractor to disclose any discrepancies with qualifications on the initial bid document.

1.5 SUBMITTALS

- A. Kitchen Equipment Contractor's use of any Design Teams' contract drawings for basis of producing their submittal drawings, is with the following conditions and understanding:

1. The consultants Revit model will not be distributed or available to Kitchen Equipment Contractor.
2. Kitchen Equipment Contractor's, when using any Design Teams' exported AutoCAD drawings for basis of producing their submittal drawings, assumes total liability and responsibility for accuracy, and for conformance and verification with the latest Architectural and Engineering drawings, actual field conditions, and all equipment provided. An AutoCAD export is to never be used in the place of the final published documents or it's addendums.
3. Kitchen Equipment Contractor further assumes responsibility for coordination of their submittals with those of other Contractors and Sub-Contractors, as required.
4. Submittals to have Kitchen Equipment Contractor's title block and information.
5. A pdf copy of all associated submittal sheets to be substituted instead of hard copies when coordinated with architect and overall project written conditions.
6. Kitchen Equipment Contractor to note accepted alternates with all MEP related variances to published documents. Kitchen Equipment Contractor to coordinate variances with other trades for smooth installation.
7. Kitchen Equipment Contractor to provide cover sheet with any known variances found throughout set for comment by design team.

B. Product Data Manuals:

1. Submit a pdf copy to include cover sheets with detailed information and cut sheets on every item included in this Section for review by the Design Team. After review process, Kitchen Equipment Contractor to distribute pdf copy for record and construction purposes. Six (6) hard copies within a three ring binder to be provided if requested by architect or design team member. Kitchen Equipment Contractor to distribute one additional copy of installation and start-up instructions to the Installer.
2. The Product Data Manual shall be organized in sequential order and formatted so that each item has a cover page, manufacturer cutsheet (unless cover page references a shop drawing) and all the information in the following conditions:
 - a. Detailed information is to include, but not be limited to, item number, description, quantity, model number, options and accessories with accessory model number provided, N.E.M.A. plug and receptacle configuration for applicable items, clearance requirements for access and maintenance, exact utility requirements, and etc. General cut sheets with multiple model numbers are to have the specific specified item identified in an obvious manner.
3. Every cover sheet and associated detailed submittal is to provide sufficient and complete information for the Design Team to verify that the Kitchen Equipment Contractor understands the Contract requirements and is providing each item in compliance with the Contract documents.
4. Cover sheets to also include associated items as listed on the Equipment Plan but provided by others; and are to be noted as "Not in Contract -114000" in bold font.
5. Coversheets that are associated with a Shop Drawing should be noted as "See Shop Drawing" in bold font. In cases where shop drawings are included, no cut sheet is required for this instance.

6. Reproduction of any part of the Contract Specifications will not be acceptable as part or total of Kitchen Equipment Contractor's Product Data Submittal Manuals. These manuals are to be produced and assembled entirely by the Kitchen Equipment Contractor.

C. Shop Drawings:

1. Submit a 24" x 36" (min) pdf bundled copy to include cover sheets and detailed information on every item included in this Section for review by the Design Team. To be separate pdf files from the Product Data Manual and is to be broken up by manufacturer, Shop Drawings may not be included in the Product Data Manual in place of a cutsheet.
2. After corrections made from review process, Kitchen Equipment Contractor to distribute pdf copy for record and construction purposes. Six (6) hard copies to be provided if requested by architect or design team member.
3. For any equipment requiring field assembly, including but not limited to, cooking suite assemblies, custom stainless steel products, pulper/extractor assemblies, remote refrigeration systems, walk-in coolers and/or freezers, exhaust hoods/ventilators, fire suppression system, utility distribution systems, pot/utility/ware washing assemblies/machines, and conveyors - Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.
4. Before proceeding with the fabrication or manufacture of any item, Kitchen Equipment Contractor is responsible for verifying and coordinating all dimensions and details, with site dimensions, conditions, and adjacent equipment. The Kitchen Equipment Contractor is responsible for coordinating and reviewing all shop drawings with owner/owner's representative.
5. Reproduction of any part of the Contract Drawings will not be acceptable as part or total of Kitchen Equipment Contractor's Shop Drawing Package. These drawings are to be prepared and assembled entirely by the Kitchen Equipment Contractor.

D. Rough-In Drawings for Non-Altered Plans:

1. Rough-in locations have been prepared before the award of this contract; Kitchen Equipment Contractor is to examine the plans and facility.
2. Indicate locations for additional wall backing for foodservice equipment.
3. Kitchen Equipment Contractor is not to distribute any reproduced drawings in which the Design Team drawings would display like information.
4. Any errors in the project caused by reproduced drawings or non-coordinated changes will be at the full expense of the contractor responsible.

E. Equipment Plan & Rough-In Drawings for Altered Plans:

1. In instances where the Kitchen Equipment Contractor identifies a layout change due to an owner requested change sent directly to the Kitchen Equipment Contractor. Kitchen Equipment Contractor is to submit plans of the changed area showing the exact changes and matching the following conditions:
2. Submit pdf copy for review by the Design Team. After corrections from the review process, Kitchen Equipment Contractor to adjust, reproduce (if necessary) and supply six (6) sets for distribution prints of record and construction purposes.
3. Submit 1/4"=1' scale drawings. These drawings are to include complete information on the work included in the Contract, with references to equipment as provided by others; and

are to provide sufficient information for associated trades, contractors, and/or sub-contractors to complete their division of work associated with food service equipment included in this Contract. They are to be dimensioned; showing locations of ducts, stubs, floor and wall sleeves, for ventilation, plumbing, stem, electrical, refrigeration lines, and concrete base and curb dimensions, as required for equipment so supported, and any additional information pertinent to the installation of this equipment.

4. Drawings to also include equipment plan(s) with detailed equipment list, similar to Foodservice Equipment Plans included in the Contract Drawings. Item numbers are to be the same as shown in the contract Documents and are to include Not Used identifiers and associated items as provided by others. Include plans and elevations, clearance requirements for equipment access and maintenance, details of support for equipment, and utility service characteristic.
5. In the event rough ins have been accomplished before award of this contract, Kitchen Equipment Contractor is to examine the built conditions and make adjustments to their equipment to suit building conditions and utilities, where possible. If not possible, so state in a letter, with reasons and an alternate method and pricing for their equipment, to the Architect.
6. Plans prepared by the Kitchen Equipment Contractor assume all design liability for area shown when plans are utilized for construction, bidding or when distributed without proper notation that plan is "not for construction."

F. Operation and Maintenance Data:

1. Submit a pdf copy to include cover sheets and detailed information on every item included in this Section for review by the Design Team. After corrections from the review process, Kitchen Equipment Contractor to distribute pdf copy for record and post construction purposes. Three (3) hard copies within a three ring binder to be provided if requested by architect or design team member. Three (3) hard copies and two (2) pdf copies in CD/Compact Disk, DVD or thumb/flash drive format to be furnished are to be furnished to the owner upon completion and approval of Operation and Maintenance Data. Kitchen Equipment Contractor may clarify what owner would prefer and adjust delivery to request.
2. Operation and Maintenance Manual to be organized and tabbed by manufacturer with a brief list of items at the start of each manufacturer; each item to have a cover page to match the submittal book but to include the service agency information and utility information that may be needed during a service call. The manual is to include any item which was purchased from a manufacturer as a pre-engineered product containing electrical connections, plumbing connection, and/or gas connections. Any equipment matching this description which does not have an Operations & Maintenance Manual prepared by the manufacturer is to have a complete cover page with "No manufacturer manual available" at the bottom of the cover page in bold font. Duplicate items which share a common Operations and Maintenance Manual may share a cover page and manual; however, cover page is to note each instance of item. In projects where the owner labels the equipment with a property tag or other designation, Kitchen Equipment Contractor is to include this information on the cover page.
3. Sets are to be furnished to the owner in the above quantity on/or before the date of the first event to occur of the following: demo/start-up, start-up for intended use by the Owner/Operator, completion of installation of kitchen equipment contract package, or final acceptance of installation by Owner. Manuals are to be in alphabetical order with

- tabbed dividers per manufacturer. Manufacturer's info is to include Technical Services telephone number, email, and web site address, where available.
4. Kitchen Equipment Contractor to include a single index sheet with unit model and unit serial number for each item located at the front of the Operation and Maintenance manual prior to local service agency sheet. Index to be organized by manufacturer to match the manual.
 5. Provide a complete list of local service agencies for included manufacturers, complete with address and telephone numbers. Also provide email and web site addresses, where available.
 6. Provide DVD's for maintenance, training, operation, etc, where available.
- G. Product samples that are required for examination to verify color or finish style are to be furnished at no expense to Owner.
- H. Design Team's review of submittal drawings, shop details, product data brochures, and operation and maintenance manuals is for general conformance with the design concept and contract documents. Review markings or comments are not to be construed as relieving Kitchen Equipment Contractor from compliance with the contract documents, or departures there from. Kitchen Equipment Contractor remains responsible for details and accuracy, confirming and correlating all quantities and dimensions, selecting fabrication processes, techniques of assembly, and performing their work in a safe, satisfactory, and professional manner.
- I. Quality Control of Submissions:
1. The Kitchen Equipment Contractor is responsible for ensuring that all shop drawings, product data, samples, and submittals contain all information to design intent as required by the Contract Documents to allow the Design Consultant to take action.
 2. The Kitchen Equipment Contractor shall pay the Design Consultant's cost for any re-submission of any rejected item. Such costs shall be deducted from the contract sum by Change Order. The Kitchen Equipment Contractor agrees that any action taken by the Design Consultant is solely in the Design Consultant's discretion and is non-negotiable for the purposes of the Design Consultant's cost recovery for multiple (i.e. more than one) review.

1.6 SCHEDULE

- A. Time management is critical and acceptance constitutes assurance that the Kitchen Equipment Contractor can and will obtain materials, equipment and manpower, to permit installation of the items included in this Section, on schedule. Kitchen Equipment Contractor is to coordinate their work with the progress schedules and updated periodically by the General Contractor or Construction Manager.
- B. Anticipated delays, not within the control of the Kitchen Equipment Contractor, are to be noted in a written notification to the Architect, immediately upon the Kitchen Equipment Contractor's realization that delays are imminent.
- C. Failure of manufacturers to meet promised delivery dates will not grant relief to the Kitchen Equipment Contractor for failure to meet schedules; unless the Kitchen Equipment Contractor

can establish, in writing, that orders were received by the manufacturer, with reasonable lead times.

- D. Extra charges resulting from special handling or air shipment in order to meet the schedule will be paid by the Kitchen Equipment Contractor, if insufficient time was allowed in placing factory orders.

1.7 QUALITY ASSURANCE

A. Compliance with the following:

1. Air Conditioning and Refrigeration Institute (A.R.I.): applicable regulations and references of the latest edition of standards for remote refrigeration systems(s), components and installation.
2. American Society of Heating, Refrigeration and Air Conditioning Engineers (A.S.H.R.A.E.): applicable regulations and references of the latest edition of standards for remote refrigeration system(s), components and installation.
3. American Welding Society (A.W.S.): D1.1 structural welding code.
4. National Electric Code (N.E.C.): N.F.P.A. Volume 5 for electrical wiring and devices included with foodservice equipment, A.N.S.I. C2 and C73, and applicable N.E.M.A. and N.E.C.A. standards.
5. National Sanitation Foundation (N.S.F.): latest Standards and Revisions. Provide N.S.F. Seal of Approval on each applicable item. (UL Sanitation approval and seal accepted if acceptable to local code jurisdictions.)
6. U. S. Department of Health and Human Service Food Code: Latest Standards and Revisions.
7. Sheet Metal and Air Conditioning Contractor's National Association (S.M.A.C.N.A.): latest edition of guidelines for seismic restraint of kitchen equipment, as applicable to project location.
8. Underwriters Laboratories (U.L.): as applicable for electrical components and assemblies. (Canadian Standards Association or alternate testing lab's seals accepted if acceptable to local code jurisdictions.)
9. Intertek ETL SEMKO (E.T.L.): as applicable for electrical components and assemblies. Listed Mark is an accepted alternative to UL. (Canadian Standards Association or alternate testing lab's seals accepted if acceptable to local code jurisdictions.)
10. American with Disabilities Act (A.D.A.): as applicable to this Project.
11. Refrigeration Service Engineers Society (R.S.E.S.): applicable regulations and references of the latest edition of standards for remote refrigeration system(s), components and installation.
12. All refrigerants used for any purpose is to comply with the 1999 requirements of the Montreal Protocol Agreement, and subsequent revisions and amendments. No CFC refrigerants will be permitted on this Project.
13. All factory built refrigeration cooling equipment shall be tested in accordance with UL 1995.
14. All refrigeration components installation, repairs, and/or associated work on any refrigeration system, is to be performed by a Certified Refrigeration Mechanic.
15. All Applicable local codes, standards and regulations.
16. Uniform Mechanical Code (UMC): Comply with requirements of the current UMC.

1.8 MANUFACTURERS

- A. Basis-of-Design Product: The design for foodservice equipment item is based on the product named. Subject to compliance with requirements, provide either the named product or submit a substitution request for comparable equipment, see section 1.9. Manufacturers not approved as substitutions, or included as a Listed Alternates will not be permitted.
- B. Equipment models, accessories, utility requirements and dimensions are based on the latest manufacturer/fabricators data available at time of document preparation. It is possible that some or all the manufacturers' information could change between time of preparation of these documents and final construction. It is the responsibility of the Kitchen Equipment Contractor to verify that all revised equipment being provided meets the specification data, and if changed, notify appropriate trade contractors. Kitchen Equipment Contractor to include the successor model to the originally specified item and manufacturer. If the specified manufacturer has discontinued a specified model number, the Kitchen Equipment Contractor is to provide an alternate manufacturer and model number via PR/ ASI for design team to review and approve.

1.9 SUBSTITUTIONS

- A. The foodservice equipment for this project has been closely coordinated with the owner/operator. All requests for alternatives or substitutions will be coordinated through the architect. Comparable products to have prior approval and any substitution must meet or exceed the performance, style, materials, utility savings, manufacturing materials and/or operating techniques of the specified equipment. Owner reserves the right to approve or disapprove any items that are submitted for substitution and is not required to give the reasons for the decision.
- B. When approved alternates are utilized, KEC to identify on cover letter the use of approved alternates and state specifics about each instance. This to include manufacturer, model number and all specified accessories
- C. Substitution request forms available upon request.
- D. Completed substitution request forms to be filed ten (10) business days prior to bid date. Substitution requests made after the project addendum closing date will not be accepted. Substitutions made after the bid closing date will not be accepted.
- E. Submit itemized bids with the primary manufacturers and models specified. Unless otherwise noted, substitutions may be submitted for consideration, but must be itemized at the end of the bid proposal.
- F. Substitutions must be approved in writing by the Architect and/or Owner, prior to utilization in this Contract. A copy of the approval must be included with any submittals by Kitchen Equipment Contractor.

1.10 APPROVED SUBSTITUTIONS AND/OR LISTED ALTERNATES

- A. Substitutions approved as noted in article 1.9. and/or any Listed Alternate manufacturers included in the Itemized Specifications, or added by Addendum, may be utilized, in lieu of the primary specified manufacturer with the following conditions:
1. These contract documents are designed and engineered using the primary specified manufacturer and model. Kitchen Equipment Contractor assumes total responsibility for any deviations required, due to utilization of a substitution/alternate manufacturer or model; including, but not limited to, fitting alternates into available space, providing directions for required changes, and assuming any associated cost for utility, building, architectural, or engineering changes.
 2. Kitchen Equipment Contractor is responsible for supplying the model, which is equal to the primary specified model in regard to general function, features, options, sizes, accessories, utility requirements, finish, operation, and listing approvals. If it is determined by the Owner or their appointed representative at any time during the construction and installation, and prior to the final acceptance of the Project, that the substitution/alternate model submitted is not equal to the primary specified model, the Kitchen Equipment Contractor will assume all associated cost and implications required to replace the model submitted, with the correct model.
 3. The bid proposal is to clearly state any substitutions/alternates, which will be utilized including the manufacturer and model number. Also include product cut sheet for each substitution/alternate, with any and all deviations between the primary specified manufacturer and the substitution/alternate manufacturer. Complex alternates such as utility distribution systems, exhaust hoods, ventilators, etc. are to include a shop drawing specific to the Project.
 4. Inclusion of an alternate manufacturer in Itemized Specifications article 2.1 is not intended to indicate that there is an equal alternate unit to match every primary specified unit. It is the responsibility of the Kitchen Equipment Contractor to ensure that the alternate unit submitted matches the primary specified unit; and meets the conditions as stated above.
 5. Manufacturers not approved as substitutions or included as a Listed Alternates will not be permitted.

1.11 DISCREPANCIES

- A. Where discrepancies are discovered between the drawings and the specifications, regarding quality or quantity, the higher quality or the greater quantity is to be included in the Bid Proposal.
- B. Kitchen Equipment Contractor is responsible for verifying and coordinating all items provided in this Section, with the drawings, specifications, manufacturer's requirements, submittals, actual site conditions, adjacent items, and associated (Sub-) Contractors; to assure that there are no discrepancies or conflicts. This is to include, but not be limited to, quantities, dimensions, clearances required, direction of operation, door swings, utilities, gas type, elevation calibration, fabrication details and methods, installation requirements, etc.
- C. Before undertaking each part of the work, Kitchen Equipment Contractor shall carefully study and compare the contract documents and check and verify pertinent figures therein and all

applicable field measurements. Kitchen Equipment Contractor shall promptly report in writing to architect any conflict, error, ambiguity, or discrepancy which Kitchen Equipment Contractor may discover and shall obtain a written interpretation or clarification from architect before proceeding with any work affected.

- D. Kitchen Equipment Contractor will be solely responsible for any unauthorized foodservice related changes. All foodservice related changes/ alterations are to have written approval from hc.design prior to ordering, manufacture or implementation.

1.12 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements to assure accurate fit of fabricated equipment. Do not fabricate equipment until site dimensions have been field verified by fabricator or Kitchen Equipment Contractor. Indicate measurements on Coordination Drawings for all custom fabricated or critical dimensioned equipment.
- B. Check electrical characteristics and water, steam, and gas pressure. Provide pressure regulating valves and appropriate orifices where required for proper operation of equipment. It is the sole responsibility of the Kitchen Equipment Contractor to coordinate with General Contractor, verify and adjust equipment gas type and elevation requirements (regulator and orifices) for optimal performance to site specifications regardless of original gas type/elevation provision. Extra charges resulting from KEC not confirming gas type and elevation prior to foodservice equipment ordering will be paid by the Kitchen Equipment Contractor.
- C. Water Conditions: For projects with steam equipment (steamers, combi-ovens -boiler less or boiler based), booster heaters, sink heaters, hot water dispensers, warewashing equipment, glasswashers, soda systems or ice machines - an independent water test is to be performed by the Kitchen Equipment Contractor to check attributes of potable water. Total Dissolved Solids, Total Hardness, Chlorides, Chloramines, Ammonia, Chlorine, Silica, pH, Iron and all applicable agents that can adversely affect equipment are to be checked and cataloged by the Kitchen Equipment Contractor. Test results to be distributed to the general contractor then design team and engineers for review of project conditions and requirements prior to installation of any applicable foodservice equipment. Coordination and verification of specified in line filtration equipment prior to sourcing or installation.
- D. Kitchen Equipment Contractor to coordinate size and location requirements with appropriate trade contractors who are responsible for outside wall and roof penetrations required to accommodate refrigeration lines, ventilation ducting, etc.

1.13 COORDINATION

- A. Kitchen Equipment Contractor is responsible for obtaining any documents referenced in this Section and on any associated drawings, which contains information relative to the performance of this contract; and disseminating and coordinating the pertinent information contained in them, with the appropriate sub-contractors, manufacturers, fabricators, and/or installers.
- B. Coordinate location and requirements of utility service connections if deemed different than plan set.

1.14 WARRANTY

- A. Unless otherwise noted in Related Divisions / Sections 2.1, items furnished are to be fully guaranteed against defects in workmanship, materials and functionality for one (1) full year from the date of the first event to occur of the following: date of issue of Certificate of Occupancy (or the equivalent), start-up for intended use by the Owner/Operator, completion of installation of kitchen equipment contract package, or final acceptance of installation by Owner. Should a Temporary Certificate of Occupancy be issued for partial completion of work, the items furnished within that designated area are to be under warranty from the date of issue of the Certificate. Kitchen Equipment Contractor or their service agent will make necessary repairs and replacements without charge to the Owner, and within a reasonable time.
- B. Refrigeration Warranty: in addition to the one (1) year warranty requirements as stated above, provide start-up, and parts and labor for the first year; plus, additional (4) four-year extended warranty on compressors. Extended warranty is for provision of replacement compressor, determined to be defective by a Certified Refrigeration Mechanic. However, verification of defective compressor, installation of replacement compressor, recharging and repairs of system will be the responsibility of the Owner. This includes all items with built-in or remote refrigeration system.
- C. Periodic routine maintenance, servicing, adjustments, cleaning, etc., as required by the manufacturers included in this Project, are the responsibility of the Owner.
- D. Any and all parts or requirements for manufacturer's warranties to be in effect, whether or not noted in the itemized specifications, are to be provided or complied with by the Kitchen Equipment Contractor. This is to include, but not be limited to, particular parts, accessories, or installation; installation supervision, start-up, and/or follow-up inspections required by factory trained, Certified, and/or authorized personnel. Factory training, Certification, and/or authorization are to be in effect at the time of bidding, installation, start-up, and warranty period of Project.
- E. Manufacturer's warranties which comply with the requirements of this Warranty article 1.14 are to be provided in lieu of Kitchen Equipment Contractor's own warranties, where available. Copies of the written warranties are to be included in Section 1.5.F, the Operation & Maintenance manuals.
- F. Kitchen Equipment Contractor to perform (11) eleven month warranty inspection. Correct items noted by reviewing agent, issue report for all equipment and areas pertaining to the foodservice equipment and design intent.

PART 2 PRODUCTS

2.1 FOODSERVICE EQUIPMENT

Refer to manufacturer's directions for additional information not shown on the drawing or specifications. Specified manufacturer establishes quality and function.

- A. ITEM 1 - Double REACH-IN REFRIGERATOR (3 REQ'D)
Beverage Air HRP2HC-1S. Dimensions: 85(h) x 52(w) x 33.88(d)
Horizon Series Refrigerator, Reach-in, two-section, 45.2 cu. ft., self-contained refrigeration, (2) full-height solid doors (hinged left/right), (3) epoxy coated shelves per section (factory installed), stainless steel front, anodized aluminum sides & interior, microprocessor control with LED display, LED interior lights, 6" high casters, non-flammable R-290 refrigerant, 1/3 HP, cULus, NSF
1 ea 6-year parts & labor and 7 year compressor, standard.
1 ea 115v/60/1-ph, 6.0 amps, NEMA 5-15P, standard
- B. ITEM 2 - Single REACH-IN REFRIGERATOR (1 REQ'D)
Beverage Air Model HBR27HC-1. Dimensions: 84.13"(h) x 30"(w) x 33.75"(d)
Horizon Series Refrigerator, Reach-in, one-section, 25.97 cu. ft., self-contained refrigeration, (1) full-height solid door (hinged left), (3) epoxy coated shelves per section (factory installed), stainless steel front, anodized aluminum sides & interior, microprocessor control with LED display, LED interior lights, 6" high casters (2 locking), non-flammable R-290 refrigerant, 1/4 HP, cULus, NSF
1 ea 6-year parts & labor and 7 year compressor, standard.
1 ea 115v/60/1-ph, 3.0 amps, NEMA 5-15P, standard
- C. ITEM 3 - Double REACH-IN FREEZER (1 REQ'D)
Beverage Air Model FB49HC-1S Dimensions: 84.25(h) x 52(w) x 35(d)
Dealer's Choice Freezer, Reach-in, one-section, 46.2 cu. ft., self-contained refrigeration, microprocessor control with LED display, stainless steel front, (2) full-height solid doors (hinged left/right), anodized aluminum sides & interior, (3) epoxy coated shelves (factory installed), LED interior lights, 6" high locking casters, eco-friendly, non-flammable R-290 refrigerant, unit can be programmed to operate at -10°F, 3/4 hp, cULus, NSF
1 ea 6-year parts & labor and 7 year compressor, standard.
1 ea 115v/60/1-ph, 11.0 amps, NEMA 5-15P, standard
- D. ITEM 4 - Single REACH-IN FREEZER (1 REQ'D)
Beverage Air Model FB27HC-1S. Dimensions: 84.13"(h) x 30"(w) x 33.75"(d)
Vista Series Freezer, Reach-in, one-section, 25.97 cu. ft., self-contained refrigeration, microprocessor control with LED display, stainless steel front, full-height solid door (hinged right), anodized aluminum sides & interior, (3) epoxy coated shelves (factory installed), LED interior lights, 6" high locking casters, eco-friendly, non-flammable R-290 refrigerant, unit can be programmed to operate at -10°F, 3/4 hp, cULus, NSF
1 ea 6-year parts & labor and 7 year compressor, standard.
1 ea 115v/60/1-ph, 7.5 amps, NEMA 5-15P, standard
- E. ITEM 5 - DISHWASHER, Under counter (2 REQ'D)
CMA Dishmachines Model L-1X16 W/Heater. Dimensions: 34.5(h) x 24(w) x 23.5(d)
Undercounter dishwasher with sustainer heater, low temperature chemical sanitizing, (30) racks/hour, 16"H dish clearance, built-in chemical pumps and deliming system, built-in primer switches & instant start, upper and lower stainless steel wash arms with reinforced end caps, pumped drain, pump purging system, built-in stainer for water inlet, door safety switch,

electrical components housed in stainless steel drawer, stainless steel construction, includes (1)
open & (1) peg rack, 1 HP wash pump, NSF, UL, CUL
1 ea 6-year parts & labor, standard.
1 ea 115v/60/1-ph, 16.0 amps, NEMA 5-15P, standard

2.2 FABRICATION, GENERAL

- A. Fabricate food service equipment according to NSF 2 requirements. Fabricate equipment to greatest extent possible.
- B. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Provide ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
- C. Welded Butt Joints: Provide full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
- D. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
- E. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and not depressed.
- F. Coat unexposed stainless-steel welded joints with suitable metallic-based paint to prevent corrosion.
- G. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A 780.
- H. Fabricate field-assembled equipment prepared for field-joining methods indicated. For metal butt joints, comply with referenced SMACNA standard, unless otherwise indicated.
- I. Where stainless steel is joined to a dissimilar metal, use stainless steel welding material or fastening devices.
- J. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.
- K. Sealants shall only be used to seal joints and seams that are structurally sound and are less than 1/8 in (0.13 in, 3.2 mm) wide before sealing. Sealants may be used to fill spaces around collars, grommets, and service connections.
- L. Equipment shall be designed and manufactured to prevent the harborage of vermin and the accumulation of dirt and debris, and to permit the inspection, maintenance, servicing, and cleaning of the equipment and its components.
- M. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.

- N. Provide surfaces in food zone, as defined in NSF 2, free from exposed fasteners.
- O. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.
- P. Provide pipe slots on equipment with turned-up edges and sized to accommodate service and utility lines and mechanical connections.
- Q. Provide enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets, unless otherwise indicated.
- R. Seismic Restraints: Fabricate to comply with referenced SMACNA standard, unless otherwise indicated.

2.3 MATERIALS

- A. Stainless-Steel Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304, stretcher leveled, and in finish specified in "Stainless-Steel Finishes" Article.
- B. Stainless-Steel Tube: ASTM A 554, Grade MT-304, and in finish specified in "Stainless-Steel Finishes" Article.
- C. Zinc-Coated Steel Sheet: ASTM A 653, G115 (ASTM A 653M, Z350) coating designation; commercial quality; cold rolled; stretcher leveled; and chemically treated.
- D. Zinc-Coated Steel Shapes: ASTM A 36 (ASTM A 36M), zinc-coated according to ASTM A 123 requirements.
- E. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Provide elastomeric sealant NSF certified for end-use application indicated. Provide sealant that, when cured and washed, meets requirements of Food and Drug Administration's 21 CFR, Section 177.2600 for use in areas that come in contact with food. Clear sealant is the only color to be used.
- F. Backer Rod: Close-cell polyethylene, in diameter larger than joint width.
- G. Plastic: Except for plastic laminate, provide plastic materials and components complying with NSF 51.
- H. Gaskets: NSF certified for end-use application indicated, of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds.
- I. Installation Accessories, General: NSF certified for end-use application indicated.
- J. Public Health and Safety Requirements:
 - 1. Sealant is certified for compliance with NSF standards for end-use application indicated.
 - 2. Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.

- K. Cylindrical Sealant Backing: ASTM C 1330, Type C, closed-cell polyethylene, in diameter larger than joint width

PART 3 EXECUTION

3.1 PRODUCT HANDLING

- A. Kitchen Equipment Contractor is responsible for receiving and warehousing equipment and fixtures, until ready for installation. Store materials, equipment and fixtures in sealed containers, where possible. Store off the ground and under cover, protected from damage.
- B. Receive all equipment, inspect and warehouse until scheduled installation. If any damage is noted; return to manufacturer, and replace with new undamaged equipment. All equipment replacements to not affect the final delivery and installation schedule.
- C. Do not install equipment that has been damaged either in manufacture, shipment or storage.

3.2 INSTALLATION

- A. Kitchen Equipment Contractor to verify and coordinate conditions at the building site, particularly door and/or wall openings, and passages, to assure access for all equipment. Pieces too bulky for existing facilities are to be hoisted or otherwise handles with apparatus as required. All special handling equipment charges will be arranged for and paid for by Kitchen Equipment Contractor.
- B. The Kitchen Equipment Contractor will coordinate install location of faucets with the Plumbing Contractor and place each associated faucet and accessory as identified on foodservice plans / elevations.
- C. Install foodservice equipment level and plumb, according to manufacturer's written instructions.
 - 1. Provide cutouts in equipment, neatly formed, where required to run service lines through equipment to make final connections.
- D. Complete equipment assembly where field assembly is required.
 - 1. Provide closed butt and contact joints that do not require filler.
 - 2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish.
 - 3. Metal tops to be one-piece welded construction, including field joints.
 - 4. Field joints that are required because of size of fixture: butt joint, reinforce on underside with angles of same material, bolt together with non-corrosive bolts and nuts, field weld, grind and polish to same finish as top surface.
- E. Verify equipment access and maintenance clearance requirements of authorities having jurisdiction and of local sanitation and health codes; reflect minimum clearances on drawings.
- F. Install closure-trim strips and similar items requiring fasteners in a bed of clear sealant.

- G. Install joint sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Produce airtight, watertight, vermin-proof, sanitary joints. Clear sealant to be used.
- H. Equipment to be left ready for final electrical and plumbing connection by others.
- I. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and requirements of authorities having jurisdiction.
- J. Uni-strut not to be utilized or fastened to flooring surface in any instance. Shallow stainless steel uni-strut to be used and secured to underside of fixed equipment or walls to help in routing of water connections or drains. Routing to not impede the access, functionality or maintenance of equipment.
- K. Remove all packaging, pallets, cardboard and trashes related to the foodservice equipment and properly dispose.
- L. All work to be done in a neat workman like manner.

3.3 CLEANING AND PROTECTING

- A. After completing installation of equipment, repair any/all damaged finishes. Alert General Contractor of any observed damage.
- B. Clean and adjust equipment as required to produce ready-for-use condition.
- C. Use all means reasonable to protect the materials of this Section before, during, and after installation; and to protect the associated work and materials of the other trades.
- D. Protect equipment from theft or damage during remainder of the construction period and final acceptance by the Owner.

3.4 TESTING, START-UP, AND DEMONSTRATION

- A. Prior to testing/start up, inform Architect/ Design Consultant of intent to proceed with start up. Subsequent to testing/start up, provided a report of results to Architect.
- B. Test each item of operational equipment to demonstrate that it is operating properly, and the controls and safety devices are functioning. Repair or replace equipment which is found to be defective in its operation, including units which are below capacity or operating with excessive noise or vibration.
- C. Appoint a factory-authorized service representative or a qualified technician to instruct Owner's operating personnel in proper operation and maintenance procedures for each item of operational foodservice equipment. This instruction to be coordinated with the owner at least five (5) working days ahead of the demonstration.

END OF SECTION 114000

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manually operated roller shades with single rollers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Basis of Design: Mecho/5 Manual Shade System by Mecho Shade Systems, Inc.
- B. Subject to compliance with requirements, products by one of the following Manufacturers will also be accepted:
 - 1. Draper Inc.
 - 2. Hunter Douglas Contract.

3. Levolor.
 4. Rollease Acmeda, Inc.
 5. Pre-approved equal.
 6. Levolor
- C. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
1. Chain-Retainer Type: Manufacturer's Standard.
 2. Spring Lift-Assist Mechanisms: Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criterion is more stringent.
- D. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Roller Drive-End Location: Right side of interior face of shade.
 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
- E. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- F. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- G. Shadebands:
1. Shadeband Material: Light-filtering fabric.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Manufacturer's Standard.
 - b. Color and Finish: As selected by Architect from manufacturer's full range.
- H. Installation Accessories:
1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
 3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 - 1. Source: Roller shade manufacturer.
 - 2. Type: Manufacturer's Standard.
 - 3. Weave: Basketweave.
 - 4. Thickness: 0.035-inch.
 - 5. Openness Factor: 3 percent.
 - 6. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 - 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
 - 2. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
 - 3. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.
- B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- C. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Corian Solid Surface.
 - 1) Color, Pattern, Texture: Abalone
 - b. Pre-approved equal (substitution request required).

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WT's "Architectural Woodwork Standards."
- B. Configuration:
1. Front: 3/4 inch bullnose
 2. Backsplash: Beveled
- C. Countertops:

1. 1/2 inch thick, solid surface material with front edge built up with same material.
- D. Backsplashes: 3/4-inch- (19-mm-) thick, solid surface material
- E. Joints:
 1. Fabricate countertops without joints.
- F. Cutouts and Holes: Grommet holes at sink locations.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions.
- B. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- C. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.
- D. Install aprons to backing and countertops with adhesive.
- E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- F. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

SECTION 211313 - FIRE SPRINKLERS

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish and install an automatic sprinkler system to protect the renovated spaces for the Sheridan High School FACS Renovation project as defined herein and as outlined on the Plumbing and Fire Sprinkler Drawings.
- B. The intent of these drawings is to provide guidelines for fire sprinkler placement and pipe routing in critical areas. The fire sprinkler contractor is responsible field verification of existing conditions, design of the new fire sprinkler systems, preparation of final shop drawings based on the proceeding notes and the drawings, and the complete installation of the fire sprinkler system which meets all of the requirements outlined within these drawings, specifications, and code(s).
- C. Fire sprinkler contractor shall develop, produce, and submit engineered fire sprinkler design calculations and drawings to the authority having jurisdiction (AHJ) for review and approval. After AHJ has reviewed and approved the calculations and drawings, fire sprinkler contractor shall submit the drawings and calculations to the engineer for review and approval prior to any fire sprinkler installation.
- D. Contractor shall be responsible to relocate existing fire sprinkler heads and piping in the remodeled areas as required for new ceiling layouts, ductwork, piping, and electrical system installations. Install the new fire sprinkler heads and piping per requirements of NFPA 13. New fire sprinkler heads shall match the existing fire sprinkler head types per area.
- E. Refer to the architectural drawings and the project specifications for additional requirements. The fire sprinkler contractor shall review a full set of plans and project specifications for specific work outlines and completion dates. The fire sprinkler contractor shall make the necessary provisions and work closely with other project disciplines to complete work by the specified completion date.
- F. This project has remodel areas to the existing building; add/relocate fire sprinkler heads and piping for new wall and ceiling layouts. Contractor shall protect and preserve fire sprinkler heads throughout where work will take place above the ceiling levels. Refer to the architectural plans and fire sprinkler plans for complete sections, elevations, and floor plan details/notes. Coordinate with full drawing package for scope of work required by this contract. Contractor shall field verify all existing conditions prior to demolishing and throughout the duration of construction.
- G. Existing facility fire sprinkler drawings are available from Associated Construction Engineering, Inc. in pdf format prior to bidding and during construction. Contact Monte Roma at 307-673-5300 or email monter@acemt.com.

- H. All portions of the systems shall be installed in accordance with the drawings, details, and specifications and as required by jurisdictional authorities and codes. Jurisdictional authorities and codes shall take precedence over plans, details and specifications in the event of a dispute between the requirements of contract documents and jurisdictional authorities or codes.
- I. The position is taken that the Owner is entitled to a project which meets or exceeds the minimum requirements of nationally recognized fire protection standards. All efforts and installations shall be directed toward this end. All deficiencies as noted by fire rating bureaus, insurance service offices or jurisdictional authorities shall be corrected. No extra charges will be allowed on this account.
- J. The intent of these specifications is to describe the complete systems to be installed, including minor details of work or materials not specifically mentioned or shown, but necessary for the successful operation and completion of the installation.
- K. Work to be performed under this section shall include, but not be limited to the following:
 - 1. Automatic fire sprinkler systems.
 - a. Wet-pipe sprinkler system.
 - 1) Pipe and fittings.
 - 2) Hangers and supports.
 - 3) Earthquake bracing.
 - 4) Sprinkler heads.
- L. The following areas shall be furnished with a re-configured automatic fire protection system of type or types as required:
 - 1. All renovated spaces for the Sheridan High School FACS Renovation project.

1.2 RELATED WORK

- A. All work performed under this section of the specifications shall be subject to the requirements of both the General and Special Conditions and the Plumbing Specification.

1.3 REGULATORY AGENCIES

- A. The term jurisdictional authority used in this section of the specification shall include, as applicable, but not be limited to the following:
 - 1. Local Building Department and Fire Department.
 - 2. Insurance Services Office or Insuring Authority having jurisdiction.
 - 3. Local and State Fire Marshal.
 - 4. Owner.
- B. The design and installation of all systems of fire protection shall conform to all requirements of applicable codes and publications herein defined:

1. International Building Code
2. International Fire Code
3. NFPA 13
4. NFPA 10
5. NFPA 17
6. All State and local ordinances
7. Underwriters' Laboratories
8. Industrial Risk Insurers/Factory Mutual
9. American Society of Testing Materials
10. American National Standards Institute
11. Occupational Safety and Health Administration

1.4 SUBMITTALS

- A. The successful Contractor shall provide submittal data as required under other portions of this specification. Submittals shall conform to the instructions set forth in the General and Special Conditions of these specifications entitled Shop Drawings and Submittals.
- B. Submit shop drawings (floor plans - detailed working drawings), showing dimensions, ducts, lights, or other items affecting the fire protection systems to jurisdictional agencies for review and approval. All items identified in NFPA 13 for proper working drawings shall be complied with. The Architect will reject all submittals not in compliance. Submit all necessary shop drawings to authorities having jurisdiction.
- C. Submit all necessary shop drawings to authorities having jurisdiction. Concurrently, shop drawings shall be sent to the Architect for review. After approval from jurisdictional agencies have been returned to the Contractor, they shall be submitted to the Architect for final acceptance. These final acceptance sets shall have all agencies' stamps of review and acceptance. Where there is conflict between the Contract Drawings and/or Specifications, and the recommendations of the jurisdictional authorities, the conflict shall be brought to the attention of the Architect at least ten (10) days prior to bidding or be resolved at no cost to the Owner.
- D. Architect's review will be for general location only. It will be the Contractor's responsibility to check his drawings for interference and to do shop fabrication from measurements taken at the job site.
- E. Work on the project shall not begin until plans have been reviewed by the Architect.
- F. Full catalog information shall be submitted for approval for all materials provided.
- G. Submittals shall be compiled and submitted in PDF format. The PDF method shall be presented as one (1) entire package per submittal section with each item in the respective submittal division clearly tagged.
- H. Each item submitted must be typewritten and clearly marked as follows for purposes of identification and record. Submittals not typewritten or not marked as described below will be rejected and returned without review.

- I. A charge of \$50.00 per drawing will be charged for electronic drawings. Associated Construction Engineering, Inc. reserves the right to waive this fee.
- J. The preparation of all shop drawings and hydraulic calculations shall be accomplished and stamped by a Registered Engineer, licensed in the State of Wyoming.

1.5 ACTION SUBMITTALS

- A. Product Data: For each product indicated.
- B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.
- C. Field test reports and certificates.
- D. Operation and maintenance data.

1.6 JOB CONDITIONS

- A. The Contractor shall investigate all of the existing drawings and all of the new architectural, structural, mechanical, electrical, and plumbing finished conditions affecting the piping, and shall arrange the equipment accordingly; furnishing required fittings, offsets and accessories. Route fire protection piping to avoid interference with ductwork and drain piping. In the event it becomes necessary to make field changes in pipe locations due to building construction, the Contractor shall consult with the Architect before making any changes. Any such changes required shall be made without added cost to the Owner.
- B. The Contractor shall determine, and be responsible for, the proper locations and type of inserts for hangers, chases, sleeves, and other openings in the construction required for fire protection work, and shall obtain this information well in advance of the construction progress to avoid delay of the work.
- C. Contractor is responsible for final locations of sprinkler heads and associated routing of piping.
- D. All fees and permits specifically required for fire protection work, not obtained by others as specified elsewhere shall be applied for and paid for by this Contractor.
- E. All systems of fire protection shall be installed by a licensed (for the location of installation) Fire Protection Contractor, fully experienced in fire protection installation as specified herein.
- F. Fire Protection Contractors may be required to provide in writing, specific information as to successfully completed projects and references to show cause as to why they should be considered acceptable to the Architect.

1.7 RECORD DRAWINGS

- A. One approved set of drawings shall be maintained on the job at all times.
- B. One reproducible set of As-Built drawings shall be provided to the Architect upon completion of the work.
- C. One digital scanned pdf of As-Built drawings shall be provided to the Architect upon completion of the work.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Three (3) sets of operating and maintenance instructions shall be provided the Owner upon completion. Manuals shall include, as a minimum, the following:
 - 1. As-Built Drawings.
 - 2. Test Reports.
 - 3. Catalog cut sheets of all materials installed.
 - 4. Proof of Owner training document.

1.9 TRAINING

- A. The Fire Protection Contractor shall instruct the Owner in the operation of the systems. Instruction shall continue until the Owner is fully satisfied that he understands the operation of his system. Once completed, an Owner training document shall be signed by the Contractor and the Owner and included within the O-M Manuals.

1.10 GUARANTEES AND WARRANTIES

- A. The Fire Protection Contractor shall guarantee to the Owner in writing, all equipment and workmanship for a period of one (1) year after the fire protection system has been placed in continuous service and has been accepted by all authorities having jurisdiction.
- B. The Fire Protection Contractor shall not be held responsible for improper or negligent maintenance by the Owner after operating and maintenance indoctrination has been given the Owner.
- C. During the warranty period, if system or equipment issues arise, the Contractor shall submit a warranty report to the Architect/Engineer identifying the issue and what was done to correct the issue. The warranty report shall identify the date the issue was discovered, when the issue was resolved, and the key personal involved in resolving the issue.

1.11 QUALITY ASSURANCE

- A. Installer Qualifications: 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.
 - 1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer, licensed in the State of Wyoming.
- B. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - e. Office and Public Areas: Light Hazard.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm/sq.ft. over 1500 sq. ft.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq.ft. over 1500 sq. ft.
 - 4. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
 - 5. 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 to 90 minutes.
- C. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13 and ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

2.2 SPRINKLER HEADS

- A. Install sprinkler heads from reviewed shop drawings.
- B. All sprinklers shall be of similar design and from a single manufacturer.
- C. The operating temperature of sprinkler heads shall be as required by the specific location of installation.
- D. Sprinkler heads shall conform to the following schedule:
 - 1. Refer to FP001 and FP101 for information on styles of fire sprinkler head types to be utilized.
- E. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- F. Manufacturers:
 - 1. AFAC Inc.
 - 2. Central Sprinkler Corp.
 - 3. Firematic Sprinkler Devices, Inc.
 - 4. Globe Fire Sprinkler Corporation.
 - 5. Grinnell Fire Protection.
 - 6. Reliable Automatic Sprinkler Co., Inc.
 - 7. Star Sprinkler Inc.
 - 8. Venus Fire Protection, Ltd.
 - 9. Victaulic Co. of America.
 - 10. Viking Corp.
- G. Automatic Sprinklers: With heat-responsive element complying with the following:
 - 1. UL 199, for nonresidential applications.
 - 2. UL 1767, for early-suppression, fast-response applications.
- H. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- I. Sprinkler types, features, and options as follows:
 - 1. Pendent sprinklers.
 - 2. Quick-response sprinklers.
 - 3. Recessed sprinklers, including escutcheon.
 - 4. Sidewall sprinklers.
 - 5. Upright sprinklers.
- J. Sprinkler Finishes:
 - 1. Brass or painted as indicated on Drawings FP001 and FP101.
- K. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 1-inch vertical adjustment.
 - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

2.3 STEEL PIPE AND FITTINGS

- A. Steel pipes in this Article are arranged in order of decreasing wall thickness.
- B. Threaded-End, Standard-Weight Steel Pipe: 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. 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.
 - 4. Steel Threaded Couplings: ASTM A 865.
- C. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory- or field-formed, roll-grooved ends.
 - 1. Grooved-Joint Piping Systems:
 - a. Manufactures:
 - 1) Anvil International, Inc.
 - 2) Central Sprinkler Corp.
 - 3) Ductilic, Inc.
 - 4) JDH Pacific, Inc.
 - 5) National Fittings, Inc.
 - 6) Shurjoint Piping Products, Inc.
 - 7) Southwestern Pipe, Inc.
 - 8) Star Pipe Products; Star Fittings Div.
 - 9) Victaulic Co. of America.
 - 10) 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.
- D. Interior piping for automatic sprinkler system shall conform to NFPA 13.

2.4 HANGERS AND SUPPORTS

- A. Space pipe hangers in accord with the requirements of NFPA. Construct hangers, hanger rods, inserts and clamps as approved by the same.

2.5 EARTHQUAKE BRACING

- A. Furnish and install all earthquake bracing as required by NFPA and jurisdictional enforcing or insurance agency.

2.6 SPECIALTIES

A. Escutcheon Plates

- 1. Where exposed piping passes through finish work, chrome plated or other finish acceptable to the Architect shall be installed. Split wall plates or escutcheons shall be installed to fit snugly around piping.
- 2. Match existing sprinkler head escutcheon plates on new fire sprinkler heads throughout the Science Wing.

B. Flexible, Sprinkler Hose Fittings:

- 1. Manufacturers:
 - a. Fivalco Inc.
 - b. FlexHead Industries, Inc.
 - c. Gateway Tubing, Inc.
 - d. Victaulic Company.
- 2. Standard: UL 1474
- 3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
- 4. Pressure Rating: 175 psig.
- 5. Size: Same as connect piping for sprinkler.

PART 3 - EXECUTION

3.1 DESIGN CRITERIA

- A. The fire protection system supplier shall design the piping to supply the system. Piping shall be laid out so as not to interfere with the installation of other piping, ductwork or light fixtures.
- B. The intent is to provide complete sprinkler systems as required. This Contractor shall be responsible for surveying the site, existing construction, and new construction, and prepare working drawings for the total system.
- C. All piping shall be run concealed wherever possible. Where piping is run exposed, special notation on Contractor's drawings to that effect shall be evident and conspicuous on the drawings. Any piping determined to be a problem shall be relocated at no cost to the Owner.

- D. The preparation of all shop drawings and hydraulic calculations shall be accomplished and stamped by a Registered Engineer, licensed in the State of Wyoming.

3.2 PIPING APPLICATIONS, GENERAL

- A. Flanges, flanged fittings, unions, 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.

3.3 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. NPS 2 and Smaller: Threaded-end or grooved-end, black standard-weight (Sch. 40) steel pipe; cast- or malleable-iron threaded fittings; and threaded joints or grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. NPS 2-1/2 and Larger: Threaded-end, black standard-weight (Sch. 10) steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
- C. NPS 2-1/2 and Larger: Grooved-end, black standard-weight (Sch. 10) steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.4 JOINT CONSTRUCTION

- A. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with 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.
- B. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 - 1. Steel Pipe: Roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
- C. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
 - 1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.
 - 2. NPS 2-1/2 to NPS 4: Use dielectric flanges.
 - 3. NPS 5 and Larger: Use dielectric flange insulation kits.

3.5 INSTALLATION

- A. Furnish sprinkler system with the following components:
 - 1. The intent of the project is to add/relocate fire sprinkler heads and piping to provide coverage in all areas of remodel. All existing fire sprinkler heads shall be replaced with

- new fire sprinkler heads in the remodel area. Reference all architectural, electrical, plumbing and mechanical plans for all areas associated with work.
2. Auxiliary drains shall be provided when a change in piping direction prevents drainage of sections of branch lines or mains through the main drain valve.
- B. Where details of installation are not given, the installation shall be made using manufacturer's recommended practices or at the direction of the Architect.
 - C. Contractor shall complete the fire protection systems ready for operation, in all respects, as soon as possible. When system is complete and ready for continuous operation, activate the system for its intended use.
 - D. This Contractor shall call for inspection and obtain Certificate of Completion and Test from Fire Inspection Bureau under whose jurisdiction this installation occurs.
 - E. This Contractor shall remove from the building, all rubbish and unused materials due to or connected with this installation.
 - F. Install sprinkler piping with drains for complete system drainage.
 - G. Fire sprinkler heads shall be centered in lay-in acoustical panel ceiling tile, length and width.
 - H. Install hangers and support for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.
 - I. Contractor shall provide spare fire sprinkler heads per NFPA 13.

3.6 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. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 4. Coordinate with fire alarm tests. Operate as required.
 5. 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.

END OF SECTION 211313

SECTION 220000 - PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 MECHANICAL REQUIREMENTS

- A. The mechanical requirements are supplemental to the General Requirements of these Specifications. The Mechanical Sections shall apply to phases of the work specified, shown on the Drawings, or required to provide for the complete installation of Mechanical Systems for this project.
- B. The work shall include all items, articles, materials, operations and methods listed, mentioned, or scheduled in these specifications and the accompanying drawings. All material, equipment, and labor shall be furnished together with all incidental items required by good practice to provide the complete systems described.
- C. Examine and refer to all existing facility drawings and all new Architectural, Structural, Electrical, Technology, and Mechanical drawings and specifications for construction conditions which may affect the mechanical work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.

1.2 CODES AND STANDARDS

- A. Work shall meet the requirements of the plans and specifications and shall not be less than the minimum requirements of applicable sections of the latest Codes and Standards of the following Organizations:
 - 1. American Gas Association (AGA)
 - 2. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - 3. American Society of Mechanical Engineers (ASME)
 - 4. American Water Works Association (AWWA)
 - 5. National Electrical Code (NEC)
 - 6. National Electrical Manufacturers Association (NEMA)
 - 7. National Fire Protection Association (NFPA)
 - 8. International Building Code (IBC)
 - 9. Occupational Safety & Health Act (OSHA)
 - 10. Plastic Pipe Institute (PPI)
 - 11. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - 12. International Mechanical Code (IMC)
 - 13. International Plumbing Code (IPC)
 - 14. International Fuel Gas Code (IFGC)
 - 15. Requirements of the Serving Utility Company
 - 16. Local and State Codes and Ordinances
 - 17. SMACNA Seismic Manual

1.3 FEES AND PERMITS

- A. The Mechanical Contractor shall pay all fees and arrange for all permits required for work done under his contract and under his supervision by subcontract.
- B. All usage contracts between the Owner and the serving utilities company, such as membership and usage charges or fees, etc., for the purpose of obtaining the services for the utility company shall be applied for and paid for by the Owner unless otherwise noted.

1.4 MATERIALS AND EQUIPMENT

- A. Manufacturers trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed must have prior approval. Written prior approval must be obtained from the Architect/Engineer ten (10) days prior to bid opening. Requests are to be submitted sufficiently ahead of the deadline to give ample time for examination. The items approved will be listed in an addendum and only this list of equipment will be accepted in lieu of specified products.
 - 1. Submittals must indicate the specific item or items to be furnished in lieu of those specified, together with complete technical and comparative data on specified items and proposed items. Each specification section lists the project's pre-approved manufacturers.
- B. Mechanical equipment may be installed with manufacturer's standard finish and color except where specific color, finish or choice is indicated. If the manufacturer has no standard finish, equipment shall have a prime coat and two finish coats of gray enamel.
- C. This Contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of his work.
- D. Manufactured material and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by manufacturer unless herein specified to the contrary.
- E. This Contractor shall make the required arrangement with General Contractor for the introduction into the building of equipment too large to pass through finished openings.
- F. Store materials and equipment indoors at the job site or, if this is not possible, store on raised platforms and protect from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin. Equipment and material storage location shall be approved by the Owner.

1.5 INTENT OF DRAWINGS

- A. The drawings are partly diagrammatic and do not necessarily show exact location of piping and ductwork unless specifically dimensioned. Riser and other diagrams are schematic and do not necessarily show the physical arrangement of the equipment. They shall not be used for

obtaining lineal runs of piping or ductwork, nor shall they be used for shop drawings for piping and ductwork fabrication or ordering.

- B. The drawing plans, schematics, and diagrams indicate the general location and arrangements of piping and ducting systems. Install piping and ducting in the general areas shown on the plans. If significant routing deviations are necessary to improve the system routings or avoid unforeseen conditions contact the Engineer for review.
- C. Discrepancies shown on different plans, or between plans and actual field conditions shall be brought to the attention of the Architect/Engineer for resolution.

1.6 RESPONSIBILITY

- A. The Mechanical Contractor shall be responsible for the installation of a satisfactory and complete system in accordance with the intent of the drawing and specifications. Provide, at no extra cost, all incidental items required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.
- B. The drawings do not attempt to show complete details of the building construction which affect the mechanical installation; and reference is therefore required to the existing facility drawings, Architectural, Structural, Technology, Mechanical, and Electrical drawings and specifications and to shop drawings of all trades for additional details which affect the installation of the work covered under this Division of the Contract.
- C. Location of mechanical system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. In the event of any conflicts, the Architect/Engineer shall be consulted and his decision shall govern. Necessary changes shall be made at the Contractor's expense.
- D. Determine, and be responsible for, the proper location and character of inserts for hangers, chases, sleeves, and other openings in the construction required for the work, and obtain this information well in advance of the construction progress so work will not be delayed.
- E. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.
- F. Take extreme caution not to install work that connects to equipment until such time as complete Shop Drawings of such equipment have been approved by the Architect/Engineer. Any work installed by the Contractor, prior to approval of Shop Drawings, will be at the Contractor's risk.
- G. At all times during the performance of this Contract, properly protect work from damage and protect the Owner's property from injury or loss. Make good any damage, injury or loss, except such as may be directly due to errors in the Bidding Documents or caused by Agents or Employees of the Owner. Adequately protect adjacent property as provided by law and the Bidding Documents. Provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.
- H. The Contractor shall be responsible for damages due to the work of their Contractors, to the building or its contents, people, etc.

1.7 REVIEW

- A. All work and material is subject to review at any time by the Architect/Engineer or his representative. If the Architect/Engineer or his representative finds material that does not conform with these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at the Contractor's expense.

1.8 WORKMANSHIP

A. GENERAL

- 1. Work under this contract shall be performed by workmen skilled in the particular trade, including work necessary to properly complete the installation in a workmanlike manner to present a neat and finished appearance.

B. CUTTING, PATCHING, AND FRAMING

- 1. Obtain Architect's/Engineer's approval before performing any cutting on structural members or patching of building surfaces. Any damage to the building or equipment by this Contractor shall be the responsibility of this Contractor and shall be repaired by skilled craftsmen of the trades involved at the Contractor's expense.
- 2. Chases, openings, sleeves, hangers, anchors, recesses, equipment pads, framing for equipment, provided by others only if so noted on the drawings. Otherwise, they will be provided by this Contractor for his work. Whether chases, etc., are provided by this Contractor or others, this Contractor is responsible for correct size and locations.

1.9 COORDINATION

- A. This Contractor shall plan his work to proceed with a minimum interference with other trades and it shall be his responsibility to inform the General Contractor of all openings required in the building structure for installation of work, and to provide sleeves as required. Dimensions of equipment installed and/or provided by others shall be checked in order that correct clearances and connections may be made.

1.10 CLEAN UP

- A. Keep the premises free from accumulation of waste material or rubbish caused by his work or employees.
- B. Upon completion of work, remove materials, scraps and debris relative to his work and leave the premises, including tunnels, crawl spaces, and pipe chases in clean and orderly condition. Remove all dirt and debris from the interior and exterior of all devices and equipment. After construction is completed, wash all mechanical equipment.

1.11 DUST PROTECTION

- A. Contractor will provide suitable dust protection for all existing areas prior to beginning of cutting or demolition. Contractor will obtain approval of partition from Owner before proceeding with work involved in these rooms.

1.12 TEMPORARY FACILITIES

A. OFFICES

- 1. The Contractor may provide a temporary office for himself and for the periodic use by the Architect/Engineer.

B. REMOVAL

- 1. Contractor shall completely remove his temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.

C. LADDERS AND SCAFFOLDS

- 1. The Contractor shall provide their own ladders, scaffolds, etc. of substantial construction for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the Contractor.

D. PROTECTION DEVICES

- 1. The Contractor shall provide and maintain his own necessary barricades, fences, signal lights, etc., required by all governing authorities or shown on the drawings. When no longer needed, they shall be removed by the Contractor. The Contractor shall assume all responsibility for which the Owner may be held responsible because of lack of above items.

E. TEMPORARY FIRE PROTECTION

- 1. The Contractor shall provide all necessary first-aid hand fire extinguishers for Class A, B, C and special hazards as may exist in his own work area only in accordance with good and safe practice and as required by jurisdictional safety authority. The Contractor shall provide general area fire extinguishers only.

1.13 SHOP DRAWINGS

- A. Provide copies of manufacturer's literature and/or certified prints as soon as possible but within thirty (30) days after awarding of Contract, for items of materials, equipment, or systems where called for in specifications. Shop drawings and literature complete showing item used, size, dimensions, capacity, rough-in, etc., as required for complete check and installation. Manufacturers literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.

- B. Submittals shall be compiled and submitted in PDF format. The PDF method shall be presented as one (1) entire package with each respective submittal division clearly tagged as such.
- C. The entire Division 22 shall be submitted in one (1) package in PDF format, except as noted below.
- D. Each copy of each item submitted must be clearly marked as follows for purposes of identification and record. Submittals not marked (typewritten only) as described below will be rejected and returned without review.
 - Date:
 - Name of Project:
 - Branch of Work:
 - Submitted by:
 - Name of Contracting Company:
 - Name of Contracting Company Project Contact Person:
 - Contracting Company Phone Number:
 - Specification or Plan Reference (and Plan Code reference number where applicable):
- E. At the contractor's option, specification sections with long-lead equipment can be submitted as individual submittal packages to allow independent and expedited reviews. Contractor shall coordinate with the Engineer prior to submitting packages.
- F. Prior to their submission, each submittal shall be thoroughly checked by the Contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to the work of other trades, and conformance with sound, safe practices as to erection and installation. Each submittal shall then bear a stamp evidencing such checking and shall show corrections made, if any. Submittals requiring extensive corrections shall be revised before submission. Each submittal not stamped and signed by the Contractor evidencing such checking will be rejected and returned without review.
- G. All submittals will be examined when submitted in proper form for compliance. Such review shall not relieve the Contractor of responsibility for errors, for deviation from the contract Documents, nor for violation of sound safety practices.
- H. The Contractor shall keep in the field office one print of each submittal which has been reviewed and stamped by the Architect or Engineer.
- I. Submittals will be required for each item of material and equipment furnished as noted in specifications.
- J. Submittals which are incomplete relative to quality requirements, capacity, engineering data, dimensional data or detailed list of specialty or control equipment will be rejected. Lists shall include descriptive coding as specified or shown on drawings.

THE ENGINEER WILL PERFORM SHOP DRAWING REVIEW OF EACH ITEM; HOWEVER, SUBSEQUENT REVIEW OF ITEMS PREVIOUSLY REJECTED WILL BE BILLED TO THE CONTRACTOR AT A RATE OF \$140 PER HOUR.

K. Schedule of Shop Drawings.

1. 220523 General-duty valves for plumbing piping
2. 220529 Hangers and supports for plumbing piping and equipment
3. 220553 Identification for plumbing piping and equipment
4. 220700 Plumbing insulation
5. 221116 Domestic water piping
6. 221119 Domestic water piping specialties
7. 221316 Sanitary waste and vent piping
8. 221319 Sanitary waste piping specialties
9. 224000 Plumbing fixtures

- L. Should the contractor be required to re-submit, then the entire submittal package shall be re-submitted, unless prior permission is received from the engineer for some other method.

1.14 OPERATION AND MAINTENANCE MANUALS

- A. At the time orders are placed for any item of equipment requiring service or operating maintenance, the Contractor shall request the manufacturer furnish three (3) copies of OPERATION AND MAINTENANCE INSTRUCTIONS for each piece of equipment. These shall be included in the brochure of equipment.
- B. Operation and Maintenance manuals shall contain letter of one (1) year warranty with the start date listed.
- C. Operation and Maintenance manuals shall contain all startup reports associated with plumbing equipment.
- D. Operation and Maintenance manuals shall contain the domestic water disinfection reports as outlined in specification section 221116.
- E. Operation and Maintenance manuals shall contain the final hot water recirculation system test and balance reports for future reference.
- F. Refer to individual specification sections which outline additional devices, fixtures, and equipment which require Operation and Maintenance data to be included within the manuals.

1.15 BROCHURE OF EQUIPMENT

- A. Upon completion of work, prepare three copies of "Brochure of Equipment" containing data pertinent to equipment and systems on job. Binders containing materials shall be one or more three ring binders of sufficient number to hold all literature. Contained in binders shall be: Installation, maintenance, and operating instructions for each piece of equipment; parts lists; wiring diagrams; one copy of each shop drawing and literature submittal; record drawings, etc.
- B. All literature shall be clean, unused and filed under divider headings corresponding to the specifications.

- C. These brochures shall be submitted to the Architect/Engineer and approved by him before authorization of final payment.

1.16 AS-BUILT DRAWINGS

- A. The Contractor shall furnish to the Owner and Architect/Engineer a marked print showing the location of all concealed or underground pipe or conduit runs and other equipment installed other than as shown on the drawings. Dimension underground lines from established building lines. Indicate all installed pull boxes in conduit runs.
- B. The Contractor shall furnish to the Architect/Engineer a marked print showing the location of all mechanical equipment, plumbing fixtures, piping, ductwork, diffusers, grilles, etc. The location of any item which deviates from the bid documents shall be accurately drawn and dimensioned.
- C. All underground piping and ductwork shall be dimensioned from nearest column and/or exterior walls. The location of all maintenance related items such as duct access doors, fire dampers, isolation valves, filters, etc., shall be highlighted on as built drawing.

1.17 PLACING SYSTEMS IN OPERATION

- A. At the completion of the work and at such time as the Owner shall direct, prior to final acceptance, the Contractor performing this work shall put into satisfactory operation the various systems installed under the specifications. At no additional cost to the Owner, furnish the services of a person completely familiar with the installations performed under this specification, to instruct the Owner's operating personnel in the proper operation and servicing of the equipment and systems. These services shall be available for a period of no less than one (1) day and shall be scheduled no less than one (1) week prior to conducting.
 - 1. Once completed, an Owner training document shall be signed by the Contractor and the Owner and included within the O-M Manuals.

1.18 WARRANTY

- A. The Contractor shall guarantee that all materials and labor installed are new and of first quality and that any material or labor found defective shall be replaced without cost to the Owner within one (1) year after substantial completion of the Contract or one (1) full season of heating and cooling operation, whichever is the greater. The guarantee shall list the date of the beginning of the one (1) year period, which shall be the date that the Substantial Completion Certificate is issued.
- B. Any damage to the building, caused by defective work or material of the Contractor within the above-mentioned period, shall be satisfactorily repaired without cost to the Owner.
- C. The guarantee does not include maintenance of equipment. The Owner shall accept full responsibility for proper operation and maintenance of equipment immediately upon substantial completion and occupancy of the building.

- D. Final acceptance by the Owner will not occur until all operating instructions are mounted in Equipment Rooms and Operating Personnel thoroughly indoctrinated in the operation of all mechanical equipment by the Contractor.
- E. Any equipment, including boilers, pumps, air handlers, motors, domestic hot water heaters, re-circulating pumps, plumbing fixtures, etc., used for temporary heat, shall be brought up to a new condition before final acceptance by the Owner and shall be guaranteed by the Contractor as new equipment.
- F. During the warranty period, if system or equipment issues arise, the Contractor shall submit a warranty report to the Architect/Engineer identifying the issue and what was done to correct the issue. The warranty report shall identify the date the issue was discovered, when the issue was resolved, and the key personal involved in resolving the issue.

END OF SECTION 220000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Plumbing Demolition.
7. Equipment installation requirements common to equipment sections.
8. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing 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.

1.3 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 Plumbing 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. Increased cost for electrical work as a result of a non-specified piece of equipment shall be borne by the mechanical contractor.

PART 2 - PRODUCTS

2.1 EQUIPMENT MANUFACTURERS

- A. Equipment in each of the following categories shall be of one manufacture or available through one manufacture, or vendor, for each category to facilitate ease of maintenance for the Owner. Refer to Division 23 for similar products.
1. Thermometers.
 2. Pressure Gauges
 3. Gate, Plug, and Check Valves
 4. Ball Valves
 5. Balancing Valves
 6. Dielectric Unions
 7. Strainers

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 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 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for minimum working pressure at.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and minimum working pressure.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and minimum working pressure.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 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 PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. 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.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, 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 PLUMBING DEMOLITION

- A. Refer to Division 02 for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and associated fittings, valves and piping specialties unless otherwise noted on the drawings and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - a. Contractor shall be permitted to grout fill and fire seal existing glass piping to be abandoned in place in lieu of capping the piping with a plug with the same material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and associated duct fittings and specialties unless otherwise noted on the drawings and cap remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.

- 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 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. Install piping to allow application of continuous insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 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. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. 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.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS and smaller, adjacent to each valve and at final connections to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

- D. Install equipment to allow right of way for piping installed at required slope.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 GROUTING

- A. Mix and install grout for plumbing 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 220500

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.

1.2 SUBMITTALS

A. Product Data: For each type of valve indicated.

1. Certification that products comply with NSF 61.

B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

C. All piping, valves, and equipment for domestic water service shall comply with the Reduction of Lead in Drinking Water Act of 2011 which is being enforced as of January 4, 2014.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Refer to Division 23 11 23 "Natural Gas Piping" for valve applications and requirements to be utilized in natural gas systems.

C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- D. Valve Sizes: Same as upstream piping unless otherwise indicated.
- E. Valve Actuator Types:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Handlever: For quarter-turn valves NPS 6 and smaller.
- F. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. 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.
- G. 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.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim and threaded ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Red-White Valve Corporation.
 - e. Stockham.
 - f. Nibco.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

- B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim & Copper Pressure-Seal-Joint Ends:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nibco.
 - b. Viega.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Copper Pressure-Seal-Joint
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

PART 3 - EXECUTION

3.1 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.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.

- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.
- F. Valve Handle:
 - 1. Contractor shall not be permitted to modify the valve handle configuration from the manufacturer's configuration.
 - 2. Contractor shall position valves to permit full use and access to the valve handles.

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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where copper pressure seal joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Ball Valves: Provide with threaded ends or copper pressure-seal-joint ends.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Equipment supports.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

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 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.
 - 3. Grinnell Corp.
 - 4. National Pipe Hanger Corporation.
 - 5. PHD Manufacturing, Inc.
 - 6. Piping Technology & Products, Inc.
 - 7. Tolco Inc.
 - 8. Other manufactures meeting the specification requirements.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.

3. Power-Strut Div.; Tyco International, Ltd.
4. Tolco Inc.
5. Unistrut Corp.; Tyco International, Ltd.
6. Other manufactures meeting the specification requirements.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. ERICO/Michigan Hanger Co.
2. Pipe Shields, Inc.
3. Rilco Manufacturing Company, Inc.
4. Value Engineered Products, Inc.
5. Other manufactures meeting the specification requirements.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

1. Insert thickness shall match insulation thickness.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

1. Insert thickness shall match insulation thickness.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Empire Industries, Inc.

- c. Hilti, Inc.
- d. ITW Ramset/Red Head.
- e. MKT Fastening, LLC.
- f. Powers Fasteners.
- g. Other manufacture meeting the specification requirements.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated and insulated stationary pipes, NPS 1/2 to NPS 1 1/2.
 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-rods shall be zinc or cadmium plated steel rods and nuts.
- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

- K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- M. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

- E. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. 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, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger 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.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Clamped piping:
 - a. Piping 1-1/2" and smaller: use protection shields. Shields shall span an arc of 180 degrees.
 - b. Piping 2" and larger: use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Hanger Supported piping:
 - a. Piping 1-1/2" and smaller: use protection shields. Shields shall span an arc of 180 degrees.
 - b. Piping 2" and larger: use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping
 - 3. Protection Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

- b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
- 4. Piping Operating below Ambient Air Temperature: Insulation shall be continuous through the clamped and hanger supported piping.
 - 5. Piping Operating above Ambient Air Temperature: Clamp or Hanger may project through the insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and 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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Contractor shall verify all pipe hanger locking nuts have been re-tightened after the pipe insulation has been installed through each pipe hanger. Contractor shall thoroughly review and re-tighten all locking nuts on all pipe hangers after insulation has been installed.

3.6 PAINTING

- A. Touch Up: 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.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe labels.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pre-tensioned Pipe Labels: Pre-coiled, semi rigid plastic formed to partially cover circumference of pipe and to attach to pipe with or without a fasteners or adhesive.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings.
- B. Pipe Label Color Schedule:
1. New Domestic Water (Hot 110, Hot 140, Cold, Recirc. 110, Recirc. 140, Sanitary, and Compressed Air Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - c. Flow Directional Arrows: Show flow direction.
 2. Natural Gas Piping: See specification section 230553 "Identification for HVAC Piping and Equipment".
 3. Primary Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
 - a. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied jackets.
8. Tapes.
9. Securements.
10. Corner angles.

B. Related Sections include the following:

1. Division 23 Section "HVAC Insulation."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 4. Solids Content: 63 percent by volume and 73 percent by weight.
 5. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
- B. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.
 6. For indoor applications, 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).

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.1 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Factory cut and rolled to size.
 - 3. Finish and thickness are indicated in field-applied jacket schedules.
 - 4. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - 5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - 6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.2 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.

2.3 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
- B. RPR Products, Inc.; Bands.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

2.4 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. 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.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe

- insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.6 FIELD-APPLIED JACKET INSTALLATION

- #### A.
- Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FINISHES

- A. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Underground piping.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Refer to the Pipe Insulation Schedule on P001 for additional requirements.
- B. Domestic Cold, Hot, Tepid, and Recirculated Hot Water Piping 2" and less: Insulation shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Storm Drainage Piping: Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.
3. Transition fittings.
4. Dielectric fittings.
5. Escutcheons.
6. Sleeves.
7. Grout.

1.2 SUBMITTALS

- ##### A. Product Data:
- For each type of product indicated.
- ##### B. Field quality-control reports.
1. Include reports within the Operation and Maintenance Manuals upon completion.

1.3 QUALITY ASSURANCE

- ##### A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- ##### B. Comply with NSF 61 for potable domestic water piping and components.
- ##### C. All piping, valves, and equipment for domestic water service shall comply with the Reduction of Lead in Drinking Water Act of 2011 which is being enforced as of January 4, 2014.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- ##### A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- ##### A. Hard Copper Tube: ASTM B 88, Type L.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions:
 - a. MSS SP-123.
 - b. Cast-copper-alloy, hexagonal-stock body.
 - c. Ball-and-socket, metal-to-metal seating surfaces.
 - d. Solder-joint or threaded ends.
5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. Refer to the domestic water rough-in note on P-001 for additional installation requirements associated with pressure seal joint fittings.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.
- C. Plastic-to-Metal Transition Fittings:
 - 1. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.
- D. Plastic-to-Metal Transition Unions:
 - 1. Description: PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:

1. Description:

- a. Galvanized-steel coupling.
- b. Pressure Rating: 300 psig at 225 deg F.
- c. End Connections: Female threaded.
- d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

1. Description:

- a. Electroplated steel nipple complying with ASTM F 1545.
- b. Pressure Rating: 300 psig at 225 deg F.
- c. End Connections: Male threaded or grooved.
- d. Lining: Inert and noncorrosive, propylene.

2.7 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew.
- G. One-Piece Floor Plates: Cast-iron flange.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.8 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- E. 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 setscrews.

2.9 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install domestic water piping level and plumb.
- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- F. 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.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping adjacent to equipment and specialties to allow service and maintenance.
- I. Install piping to permit valve servicing.
- J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.

- M. Install sleeve seals for piping penetrations of concrete walls and slabs.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install pressure gages on suction and discharge piping from each plumbing pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- P. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. 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.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits nipples.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.

5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Install supports for vertical steel piping every 15 feet.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
5. Bare Piping in Equipment Rooms: One piece, cast brass.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.9 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. Seal space outside of sleeves in concrete slabs and walls with grout.
- H. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- I. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. PVC pipe or Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
- J. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:

- 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities. Include reports in the projects Operation and Maintenance manuals upon completion of work.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.13 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 3-inch and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.14 VALVE SCHEDULE

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.
- C. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use gate valves for piping NPS 2-1/2 and larger.
 2. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 3. Drain Duty: Hose-end drain valves.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Balancing valves.
 - 3. Temperature-actuated water mixing valves.
 - 4. Strainers.
 - 5. Drain valves.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
 - 3. All piping, valves, and equipment for domestic water service shall comply with the Reduction of Lead in Drinking Water Act of 2011 which will be enforced January 4, 2014.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Woodford Manufacturing Company.
 - c. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

2.2 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries: Bell & Gossett Div.
 - d. NIBCO INC.
 - e. Taco, Inc.
 - f. Watts Industries, Inc. Water Products Div.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Brass or bronze (Lead Free).
4. Size: Same as connected piping.
5. End Connections: Threaded.

2.3 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Leonard Valve
 - b. Powers; a Watts Industries Co.
 - c. Watts Industries, Inc. Water Products Div.
2. Standard: ASSE 1070 for point of use applications.
3. Description: As outlined on the plumbing drawings. Provide and install at all hand washing fixtures.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger. (Lead Free)
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
6. Drain: Factory-installed, hose-end drain valve.

2.5 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install thermometers and water regulators if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- E. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

3.3 FIELD QUALITY CONTROL

- A. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.4 ADJUSTING

- A. Set field-adjustable flow of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent, and storm drain piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Storm Drain Piping

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.
- C. Ceiling space above the renovation area is as a return air plenum. Do not route non-plenum rated materials inclusive of new schedule 40 pvc sanitary, vent or storm drainage piping in the return air plenum. All materials in the plenum must meet 25/50 smoke and flame spread rating.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.

1. Solvent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
 2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- B. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Under slab, soil, waste, and vent piping NPS 6 and smaller shall be any of the following:
 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Aboveground, soil, waste, and vent piping NPS 6 and smaller located in or communicating with the HVAC return air plenum shall be any of the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
- E. Under slab, storm drainage piping NPS 6 and smaller shall be any of the following:
 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- A. Aboveground, storm drainage piping NPS 6 and smaller located in or communicating with the HVAC return air plenum shall be any of the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

3.2 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

- B. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- C. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- D. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- E. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6: 60 inches with 3/4-inch rod.
- F. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 2. NPS 3: 48 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 4. NPS 6: 48 inches with 3/4-inch rod.
- I. Install supports for vertical PVC piping every 48 inches.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Connect soil and waste piping to existing sanitary sewerage piping. Use transition fitting to join dissimilar piping materials as required.
- B. Connect drainage and vent piping to the following:
 1. Plumbing Fixtures and Equipment: Connect drainage and atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
 - 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 2. Prepare reports for tests and required corrective action.

3.7 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Miscellaneous sanitary drainage piping specialties.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Floor Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Refer to the Plumbing Fixture Schedule for product basis.
- B. Wall Cleanouts:
 - 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:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M. Include wall access.
 - 3. Size: Same as connected drainage piping.
 - 4. Body: Pipe test tee as required to match connected piping.
 - 5. Closure: Countersunk, brass or cast-iron plug for metallic piping and PVC plug for plastic piping.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.2 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Trap Guards:
 - 1. Pro-Set trap guard or Rectroseal Sureseal trap guard.
 - 2. All floor drains and floor sinks shall be fitted with a Trap Guard.
- B. Air-Gap Fittings:
 - 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 - 2. Body: Bronze or cast iron.
 - 3. Inlet: Opening in top of body.
 - 4. Outlet: Larger than inlet.
 - 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- C. Sleeve Flashing Device:
 - 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 - 2. Size: As required for close fit to riser or stack piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install Trap Guard on all floor drains.
- E. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- F. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

- G. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- H. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 PROTECTION

- A. Protect drains during construction to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Faucets for sinks.
 - 2. Stainless steel sinks.
 - 3. Protective shielding guards.
 - 4. Dishwasher air-gap fittings.
 - 5. Wash machine wall box.
 - 6. Garbage Disposer.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic. E. PVC: Polyvinyl chloride plastic.
- E. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category from a single manufacture that meets the specified criteria for each category. Note: This does not preclude use of components from different manufactures in an assembly, such as lavatory and faucet.

- 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Laundry Trays: ANSI Z124.6.
 - 3. Plastic Shower Enclosures: ANSI Z124.2.
 - 4. Plastic Sinks: ANSI Z124.6.
 - 5. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 6. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 7. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 8. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 9. Vitreous-China Fixtures: ASME A112.19.2M.
 - 10. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 11. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 8. NSF Potable-Water Materials: NSF 61.
 - 9. Pipe Threads: ASME B1.20.1.
 - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 11. Supply Fittings: ASME A112.18.1.
 - 12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for shower faucets:
 - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.

2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 3. Faucets: ASME A112.18.1.
 4. Hand-Held Showers: ASSE 1014.
 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Manual-Control Antiscald Faucets: ASTM F 444.
 8. Pipe Threads: ASME B1.20.1.
 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Grab Bars: ASTM F 446.
 5. Hose-Coupling Threads: ASME B1.20.7.
 6. Hot-Water Dispensers: ASSE 1023 and UL 499.
 7. Off-Floor Fixture Supports: ASME A112.6.1M.
 8. Pipe Threads: ASME B1.20.1.
 9. Plastic Toilet Seats: ANSI Z124.5.
 10. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

- 2.1 Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category from a single manufacture that meets the specified criteria for each category. Note: This does not preclude use of components from different manufactures in an assembly, such as lavatory and faucet.
- 2.2 SINK FAUCETS
- A. Sink Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Bradley Corporation.
 - c. Chicago Faucets.
 - d. Kohler Co.
 - e. Moen, Inc.
 - f. Zurn
2. Description: As outlined on the plumbing drawings.

2.3 STAINLESS STEEL SINKS

- A. Stainless steel sinks:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Elkay
 - b. Eagle Group
 2. Description: As outlined on the plumbing drawings.

2.4 PROTECTIVE SHIELDING GUARDS OR SKIRT KIT

- A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. McGuire Manufacturing Co., Inc.
 - c. TRUEBRO, Inc.
 - d. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
 3. A skirt may be used only if it matches the cabinet material used in each area. Skirts shall be provided by the casework supplier and are shown on the architectural drawings and specifications.

2.5 DISHWASHER AIR-GAP FITTINGS

- A. Dishwasher Air-Gap Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brass Craft Mfg. Co.; a Subsidiary of Masco Corporation.
 - b. Brasstech Inc.; Newport Brass Div.
 - c. Dearborn Brass; a div. of Moen, Inc.
 - d. Geberit Manufacturing, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Watts Brass & Tubular; a division of Watts Regulator Co.

2. Description: Fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 gpm; and inlet pressure of at least 5 psig at a temperature of at least 140 deg F. Include 5/8-inch- ID inlet and 7/8- inch- ID outlet hose connections.
3. Hoses: Rubber and suitable for temperature of at least 140 deg F.
 - a. Inlet Hose: 5/8-inch ID and 48 inches long.
 - b. Outlet Hose: 7/8-inch ID and 48 inches long.

2.6 WASH MACHINE OUTLET WALL BOX

- A. Wall Boxes:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. None.
 2. Description: As outlined on the plumbing drawings.

2.7 GARBAGE DISPOSER

- A. Garbage Disposer:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. None.
 2. Description: As outlined on the plumbing drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install wall-mounting fixtures with tubular waste piping attached to supports.
- E. Install fixtures level and plumb according to roughing-in drawings.
- F. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- H. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- I. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- J. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- K. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- L. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- M. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- N. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck. Connect inlet hose to dishwasher and outlet hose to disposer.
- O. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- P. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.5 PROTECTION AND ADJUSTING

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.
- C. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- D. Adjust water pressure at faucets to produce proper flow and stream.
- E. Replace washers and seals of leaking and dripping faucets and stops. F. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.

END OF SECTION 224000

SECTION 230000 - MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 MECHANICAL REQUIREMENTS

- A. The mechanical requirements are supplemental to the General Requirements of these Specifications. The Mechanical Sections shall apply to phases of the work specified, shown on the Drawings, or required to provide for the complete installation of Mechanical Systems for this project.
- B. The work shall include all items, articles, materials, operations and methods listed, mentioned, or scheduled in these specifications and the accompanying drawings. All material, equipment, and labor shall be furnished together with all incidental items required by good practice to provide the complete systems described.
- C. Examine and refer to all existing facility drawings and all new Architectural, Structural, Electrical, Technology, and Plumbing drawings and specifications for construction conditions which may affect the mechanical work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.

1.2 CODES AND STANDARDS

- A. Work shall meet the requirements of the plans and specifications and shall not be less than the minimum requirements of applicable sections of the latest Codes and Standards of the following Organizations:
 - 1. American Gas Association (AGA)
 - 2. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - 3. American Society of Mechanical Engineers (ASME)
 - 4. American Water Works Association (AWWA)
 - 5. National Electrical Code (NEC)
 - 6. National Electrical Manufacturers Association (NEMA)
 - 7. National Fire Protection Association (NFPA)
 - 8. International Building Code (IBC)
 - 9. Occupational Safety & Health Act (OSHA)
 - 10. Plastic Pipe Institute (PPI)
 - 11. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - 12. International Mechanical Code (IMC)
 - 13. International Building Code (IBC)
 - 14. International Fuel Gas Code (IFGC)
 - 15. Requirements of the Serving Utility Company
 - 16. Local and State Codes and Ordinances
 - 17. SMACNA Seismic Manual

1.3 FEES AND PERMITS

- A. The Mechanical Contractor shall pay all fees and arrange for all permits required for work done under his contract and under his supervision by subcontract.
- B. All usage contracts between the Owner and the serving utilities company, such as membership and usage charges or fees, etc., for the purpose of obtaining the services for the utility company shall be applied for and paid for by the Owner.

1.4 MATERIALS AND EQUIPMENT

- A. Manufacturers trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed must have prior approval. Written prior approval must be obtained from the Architect/Engineer ten (10) days prior to bid opening. Requests are to be submitted sufficiently ahead of the deadline to give ample time for examination. The items approved will be listed in an addendum and only this list of equipment will be accepted in lieu of specified products.
 - 1. Submittals must indicate the specific item or items to be furnished in lieu of those specified, together with complete technical and comparative data on specified items and proposed items. Each specification section lists the project's pre-approved manufacturers.
- B. Mechanical equipment may be installed with manufacturer's standard finish and color except where specific color, finish or choice is indicated. If the manufacturer has no standard finish, equipment shall have a prime coat and two finish coats of gray enamel.
- C. This Contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of his work.
- D. Manufactured material and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by manufacturer unless herein specified to the contrary.
- E. This Contractor shall make the required arrangement with General Contractor for the introduction into the building of equipment too large to pass through finished openings.
- F. Store materials and equipment indoors at the job site or, if this is not possible, store on raised platforms and protect from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin. Equipment and material storage location shall be approved by the Owner.

1.5 INTENT OF DRAWINGS

- A. The drawings are partly diagrammatic and do not necessarily show exact location of piping and ductwork unless specifically dimensioned. Riser and other diagrams are schematic and do not necessarily show the physical arrangement of the equipment. They shall not be used for

obtaining lineal runs of piping or ductwork, nor shall they be used for shop drawings for piping and ductwork fabrication or ordering.

- B. The drawing plans, schematics, and diagrams indicate the general location and arrangements of piping and ducting systems. Install piping and ducting in the general areas shown on the plans. If significant routing deviations are necessary to improve the system routings or avoid unforeseen conditions contact the Engineer for review.
- C. Discrepancies shown on different plans, or between plans and actual field conditions shall be brought to the attention of the Architect/Engineer for resolution.

1.6 RESPONSIBILITY

- A. The Mechanical Contractor shall be responsible for the installation of a satisfactory and complete system in accordance with the intent of the drawing and specifications. Provide, at no extra cost, all incidental items required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.
- B. The drawings do not attempt to show complete details of the building construction which affect the mechanical installation; and reference is therefore required to the existing facility drawings, Architectural, Structural, Technology, and Electrical drawings and specifications and to shop drawings of all trades for additional details which affect the installation of the work covered under this Division of the Contract.
- C. Location of mechanical system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. In the event of any conflicts, the Architect/Engineer shall be consulted and his decision shall govern. Necessary changes shall be made at the Contractor's expense.
- D. Determine, and be responsible for, the proper location and character of inserts for hangers, chases, sleeves, and other openings in the construction required for the work, and obtain this information well in advance of the construction progress so work will not be delayed.
- E. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.
- F. Take extreme caution not to install work that connects to equipment until such time as complete Shop Drawings of such equipment have been approved by the Architect/Engineer. Any work installed by the Contractor, prior to approval of Shop Drawings, will be at the Contractor's risk.
- G. At all times during the performance of this Contract, properly protect work from damage and protect the Owner's property from injury or loss. Make good any damage, injury or loss, except such as may be directly due to errors in the Bidding Documents or caused by Agents or Employees of the Owner. Adequately protect adjacent property as provided by law and the Bidding Documents. Provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.
- H. The Contractor shall be responsible for damages due to the work of their Contractors, to the building or its contents, people, etc.

1.7 REVIEW

- A. All work and material is subject to review at any time by the Architect/Engineer or his representative. If the Architect/Engineer or his representative finds material that does not conform with these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at the Contractor's expense.

1.8 WORKMANSHIP

A. GENERAL

- 1. Work under this contract shall be performed by workmen skilled in the particular trade, including work necessary to properly complete the installation in a workmanlike manner to present a neat and finished appearance.

B. CUTTING, PATCHING, AND FRAMING

- 1. Obtain Architect's/Engineer's approval before performing any cutting on structural members or patching of building surfaces. Any damage to the building or equipment by this Contractor shall be the responsibility of this Contractor and shall be repaired by skilled craftsmen of the trades involved at the Contractor's expense.
- 2. Chases, openings, sleeves, hangers, anchors, recesses, equipment pads, framing for equipment, provided by others only if so noted on the drawings. Otherwise, they will be provided by this Contractor for his work. Whether chases, etc., are provided by this Contractor or others, this Contractor is responsible for correct size and locations.

1.9 COORDINATION

- A. This Contractor shall plan his work to proceed with a minimum interference with other trades and it shall be his responsibility to inform the General Contractor of all openings required in the building structure for installation of work, and to provide sleeves as required. Dimensions of equipment installed and/or provided by others shall be checked in order that correct clearances and connections may be made.

1.10 CLEAN UP

- A. Keep the premises free from accumulation of waste material or rubbish caused by his work or employees.
- B. Upon completion of work, remove materials, scraps and debris relative to his work and leave the premises, including tunnels, crawl spaces, and pipe chases in clean and orderly condition. Remove all dirt and debris from the interior and exterior of all devices and equipment. After construction is completed, wash all mechanical equipment.

1.11 DUST PROTECTION

- A. Contractor will provide suitable dust protection for all existing areas prior to beginning of cutting or demolition. Contractor will obtain approval of partition from Owner before proceeding with work involved in these rooms.

1.12 TEMPORARY FACILITIES

A. OFFICES

- 1. Contractor may provide a temporary office for himself and for the periodic use by the Architect\Engineer.

B. REMOVAL

- 1. Contractor shall completely remove his temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.

C. LADDERS AND SCAFFOLDS

- 1. The Contractor shall provide their own ladders, scaffolds, etc. of substantial construction for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the Contractor.

D. PROTECTION DEVICES

- 1. The Contractor shall provide and maintain his own necessary barricades, fences, signal lights, etc., required by all governing authorities or shown on the drawings. When no longer needed, they shall be removed by the Contractor. The Contractor shall assume all responsibility for which the Owner may be held responsible because of lack of above items.

E. TEMPORARY FIRE PROTECTION

- 1. The Contractor shall provide all necessary first-aid hand fire extinguishers for Class A, B, C and special hazards as may exist in his own work area only in accordance with good and safe practice and as required by jurisdictional safety authority. The Contractor shall provide general area fire extinguishers only.

1.13 SHOP DRAWINGS

- A. Provide copies of manufacturer's literature and/or certified prints as soon as possible but within thirty (30) days after awarding of Contract, for items of materials, equipment, or systems where called for in specifications. Shop drawings and literature complete showing item used, size, dimensions, capacity, rough-in, etc., as required for complete check and installation. Manufacturers literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.
- B. Submittals shall be compiled and submitted in PDF format. The PDF method shall be presented as one (1) entire package with each respective submittal division clearly tagged as such.

- C. The entire Division 23 shall be submitted in one (1) package in PDF format, except as noted below.
- D. Each copy of each item submitted must be clearly marked as follows for purposes of identification and record. Submittals not marked (typewritten only) as described below will be rejected and returned without review.
- Date:
Name of Project:
Branch of Work:
Submitted by:
Name of Contracting Company:
Name of Contracting Company Project Contact Person:
Contracting Company Phone Number:
Specification or Plan Reference (and Plan Code
reference number where applicable):
- E. At the contractor's option, specification sections with long-lead equipment can be submitted as individual submittal packages to allow independent and expedited reviews. Contractor shall coordinate with the Engineer prior to submitting packages.
- F. Prior to their submission, each submittal shall be thoroughly checked by the Contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to the work of other trades, and conformance with sound, safe practices as to erection and installation. Each submittal shall then bear a stamp evidencing such checking and shall show corrections made, if any. Submittals requiring extensive corrections shall be revised before submission. Each submittal not stamped and signed by the Contractor evidencing such checking will be rejected and returned without review.
- G. All submittals will be examined when submitted in proper form for compliance. Such review shall not relieve the Contractor of responsibility for errors, for deviation from the contract Documents, nor for violation of sound safety practices.
- H. The Contractor shall keep in the field office one print of each submittal which has been reviewed and stamped by the Architect or Engineer.
- I. Submittals will be required for each item of material and equipment furnished as noted in specifications.
- J. Submittals which are incomplete relative to quality requirements, capacity, engineering data, dimensional data or detailed list of specialty or control equipment will be rejected. Lists shall include descriptive coding as specified or shown on drawings.

THE ENGINEER WILL PERFORM SHOP DRAWING REVIEW OF EACH ITEM; HOWEVER, SUBSEQUENT REVIEW OF ITEMS PREVIOUSLY REJECTED WILL BE BILLED TO THE CONTRACTOR AT A RATE OF \$140 PER HOUR.

- K. Schedule of Shop Drawings.
1. 230523 General-duty valves for HVAC piping.

2. 230529 Hangers and supports for HVAC piping and equipment.
3. 230553 Identification for HVAC piping and equipment.
4. 230593 Testing, adjusting, and balancing for HVAC.
5. 230700 HVAC Insulation.
6. 230900 Instrumentation and control for HVAC.
7. 230993 Sequence of operations for HVAC controls.
8. 231123 Facility natural-gas piping.
9. 232113 Hydronic piping.
10. 232500 HVAC Water Treatment.
11. 233113 Metal ducts.
12. 233300 Air duct accessories.
13. 233423 HVAC power ventilators.
14. 233600 Air terminal units.
15. 233713 Diffusers, registers, and grilles.

- L. Should the contractor be required to re-submit, then the entire submittal package shall be re-submitted, unless prior permission is received from the engineer for some other method.

1.14 OPERATION AND MAINTENANCE MANUALS

- A. At the time orders are placed for any item of equipment requiring service or operating maintenance, the Contractor shall request the manufacturer furnish three (3) copies of OPERATION AND MAINTENANCE INSTRUCTIONS for each piece of equipment. These shall be included in the brochure of equipment.
- B. Operation and Maintenance manuals shall contain an Owner signed, Owner training document showing proof of training for all mechanical equipment and temperature control system.
- C. Operation and Maintenance manuals shall contain letter of one (1) year warranty with the start date listed.
- D. Operation and Maintenance manuals shall contain all startup reports associated with all new mechanical equipment.
- E. Operation and Maintenance manuals shall contain the final test and balance reports for future reference.
- F. Valve-tag schedule shall be included in operation and maintenance data and shall be laminated and mounted in the mechanical room in the first floor level.
- G. Refer to individual specification sections which outline additional devices, fixtures, and equipment which require Operation and Maintenance data to be included within the manuals.

1.15 BROCHURE OF EQUIPMENT

- A. Upon completion of work, prepare three copies of "Brochure of Equipment" containing data pertinent to equipment and systems on job. Binders containing materials shall be one or more three ring binders of sufficient number to hold all literature. Contained in binders shall be:

Installation, maintenance, and operating instructions for each piece of equipment; parts lists; wiring diagrams; one copy of each shop drawing and literature submittal; record drawings, etc.

- B. All literature shall be clean, unused and filed under divider headings corresponding to the specifications.
- C. These brochures shall be submitted to the Architect/Engineer and approved by him before authorization of final payment.

1.16 AS-BUILT DRAWINGS

- A. The Contractor shall furnish to the Architect/Engineer a marked print showing the location of all mechanical equipment, plumbing fixtures, piping, ductwork, diffusers, grilles, etc. The location of any item which deviates from the bid documents shall be accurately drawn and dimensioned.
- B. The location of all maintenance related items such as duct access doors, fire dampers, isolation valves, filters, etc., shall be highlighted on as built drawing.

1.17 PLACING SYSTEMS IN OPERATION

- A. At the completion of the work and at such time as the Owner shall direct, prior to final acceptance, the Contractor performing this work shall put into satisfactory operation the various systems installed under the specifications. At no additional cost to the Owner, furnish the services of a person completely familiar with the installations performed under this specification, to instruct the Owner's operating personnel in the proper operation and servicing of the equipment and systems. These services shall be available for a period of no less than one (1) day and shall be scheduled no less than one (1) week prior to conducting.
 - 1. Once completed, an Owner training document shall be signed by the Contractor and the Owner and included within the O-M Manuals.

1.18 WARRANTY

- A. The Contractor shall guarantee that all materials and labor installed are new and of first quality and that any material or labor found defective shall be replaced without cost to the Owner within one (1) year after substantial completion of the Contract or one (1) full season of heating and cooling operation, whichever is the greater. The guarantee shall list the date of the beginning of the one (1) year period, which shall be the date that the Substantial Completion Certificate is issued.
- B. Any damage to the building, caused by defective work or material of the Contractor within the above-mentioned period, shall be satisfactorily repaired without cost to the Owner.
- C. The guarantee does not include maintenance of equipment. The Owner shall accept full responsibility for proper operation and maintenance of equipment immediately upon substantial completion and occupancy of the building.

- D. Final acceptance by the Owner will not occur until all operating instructions are mounted in Equipment Rooms and Operating Personnel thoroughly indoctrinated in the operation of all mechanical equipment by the Contractor.
- E. Any equipment, including heat exchangers, boilers, pumps, air handlers, motors, etc., used for temporary heat, shall be brought up to a new condition before final acceptance by the Owner and shall be guaranteed by the Contractor as new equipment.
- F. During the warranty period, if system or equipment issues arise, the Contractor shall submit a warranty report to the Architect/Engineer identifying the issue and what was done to correct the issue. The warranty report shall identify the date the issue was discovered, when the issue was resolved, and the key personal involved in resolving the issue.

END OF SECTION 230000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. HVAC demolition.
8. Equipment installation requirements common to equipment sections.
9. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, 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 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.

1.3 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 HVAC 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.

PART 2 - PRODUCTS

2.1 EQUIPMENT MANUFACTURERS

- A. Equipment in each of the following categories shall be of one manufacture or available through one manufacture, or vendor, for each category to facilitate ease of maintenance for the Owner.
 1. Thermometers.
 2. Pressure Gauges.
 3. Gate, Plug, and Check Valves.
 4. Ball Valves.
 5. Balancing Valves.
 6. Dielectric Unions.
 7. Strainers.
 8. Air Filters.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 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 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Stainless steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 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.

2.7 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.

2.8 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 HVAC DEMOLITION

- A. Refer to Division 02 for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and associated duct fittings and specialties unless otherwise noted on the drawings and cap remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.

6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 CEILING ACCESS PANELS

- A. Provide ceiling access panels in hard lid ceilings as required to provide access to equipment, piping, piping accessories, ductwork, duct accessories etc. requiring access. Refer to Division 08 - ACCESS DOORS AND FRAMES for ceiling access panel requirements. Coordinate access panel locations with the Architect prior to installation.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 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 generally shown on the drawings. Significant deviations to layouts shall be reviewed and approved with the Engineer.
- 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. Install piping to allow application of continuous insulation.

- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 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. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. 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.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

- A. Mix and install grout for HVAC 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 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 4000 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T Insert number.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Provide shaft grounding rings for motors operated with variable frequency drives.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.

2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.

B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.

1.2 SUBMITTALS

A. Product Data: For each type of valve indicated.

B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.

- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. 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.
- F. 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.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Red-White Valve Corporation.
 - e. Stockham.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim & Copper Pressure-Seal-Joint Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nibco.
 - b. Viega.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. CWP Rating: 200 psig.
- c. Body Design: Two piece.
- d. Body Material: Bronze.
- e. Ends: Copper Pressure-Seal-Joint
- f. Seats: PTFE or TFE.
- g. Stem: Bronze.
- h. Ball: Chrome-plated brass.
- i. Port: Full.

PART 3 - EXECUTION

3.1 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.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Valve Handle:
 - 1. Contractor shall not be permitted to modify the valve handle configuration from the manufacturer's configuration.
 - 2. Contractor shall position valves to permit full use and access to the valve handles.

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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where copper pressure seal joint valve-ends or solder-joint valve-end option is indicated in valve schedules below.

3.5 HEATING HOT-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Ball Valves: Provided with solder-joint ends or copper pressure-seal-joint ends.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal hanger shield inserts.
 - 4. Equipment Supports.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

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 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.
 - 3. Grinnell Corp.
 - 4. National Pipe Hanger Corporation.
 - 5. PHD Manufacturing, Inc.
 - 6. Piping Technology & Products, Inc.
 - 7. Tolco Inc.
 - 8. Other manufactures meeting the specification requirements.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.

3. Power-Strut Div.; Tyco International, Ltd.
4. Tolco Inc.
5. Unistrut Corp.; Tyco International, Ltd.
6. Other manufactures meeting the specification requirements.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. ERICO/Michigan Hanger Co.
2. Pipe Shields, Inc.
3. Rilco Manufacturing Company, Inc.
4. Value Engineered Products, Inc.
5. Other manufactures meeting the specification requirements.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

1. Insert thickness shall match insulation thickness.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

1. Insert thickness shall match insulation thickness.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Empire Industries, Inc.

- c. Hilti, Inc.
- d. ITW Ramset/Red Head.
- e. MKT Fastening, LLC.
- f. Powers Fasteners.
- g. Other manufacture meeting the specification requirements.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.
- B. Description: Support system for the roof-mounted condensing units and power exhaust modules.
 - 1. Manufacturers:
 - a. Miro Industries.
 - 2. Pre-fabricated, hanger assembly.
 - 3. Refer to the project details on 3/M-602, for additional requirements for equipment supports

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Hanger-rods shall be zinc or cadmium plated steel rods and nuts.
- B. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- C. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- D. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

- E. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- F. Use padded hangers for piping that is subject to scratching.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated and insulated stationary pipes, NPS 1/2 to NPS 1 1/2.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Miro Industries pre-fabricated, roof-mounted pipe support system: For support of all roof-mounted piping.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- M. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. 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, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger 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.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
1. Clamped piping:
 - a. Piping 1-1/2" and smaller: use protection shields. Shields shall span an arc of 180 degrees.
 - b. Piping 2" and larger: use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Hanger Supported piping:
 - a. Piping 1-1/2" and smaller: use protection shields. Shields shall span an arc of 180 degrees.
 - b. Piping 2" and larger: use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping
3. Protection Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
4. Piping Operating below Ambient Air Temperature: Insulation shall be continuous through the clamped and hanger supported piping.
5. Piping Operating above Ambient Air Temperature: Clamp or Hanger may project through the insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and 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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Contractor shall verify all pipe hanger locking nuts have been re-tightened after the pipe insulation has been installed through each pipe hanger. Contractor shall thoroughly review and re-tighten all locking nuts on all pipe hangers after insulation has been installed.

3.6 PAINTING

- A. Touch Up: 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.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.

1.2 SUBMITTAL

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 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.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pre-tensioned Pipe Labels: Pre-coiled, semi rigid plastic formed to partially cover circumference of pipe and to attach to pipe with or without a fasteners or adhesive.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.
- C. Equipment above ceilings:
 - 1. Install an adhesive label attached to the ceiling grid marked with the respective equipment plan tag designation.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Heating Water Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - c. Flow Directional Arrows: Show flow direction.
2. Natural Gas Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - c. Flow Directional Arrows: Show flow direction.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
 - a. Constant-air volume systems.
 - b. Variable-air-volume systems.
2. Balancing Hydronic Piping Systems:
 - a. Heating Hot Water system.

B. Systems and Equipment to Balance:

1. All air and water systems associated with the new VAV terminal units listed on the mechanical drawings.
2. All new exhaust Fans and associated air systems.

C. Existing Systems and Equipment to Air Flow Test:

1. Penthouse Air Handler AHU-2.
2. All existing VAV terminal units associated with Penthouse Air Handler AHU-2: twenty-eight (28) existing VAV terminal units.
3. Refer to the following existing mechanical drawings available from Associated Construction Engineering, Inc.. Contact Monte Roma at 307.673.5300 or monter@acemt.com:
 - a. New Sheridan High School drawing M1.3 dated March 15, 1985.
 - b. New Sheridan High School drawing M1.6 dated March 15, 1985.
 - c. Sheridan County School District #2 Summer Projects, 2010 drawing M-111 dated April 28, 2010.
 - d. Sheridan County School District #2 Summer Projects, 2010 drawing MP132 dated April 28, 2010

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

- F. TDH: Total dynamic head.

1.3 SUBMITTALS

- A. Strategies and Procedures Plan: Within 100 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

1.4 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB Firm certified by NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB or TABB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."
- F. Approved Balance Contractors
 - 1. Big Horn Corporation, Billings, Montana.
 - 2. Balancing Professionals Inc, Rapid City, South Dakota.

1.5 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
- C. Coordinate and collaborate with the project's Temperature Control Contractor.

PART 2 - PRODUCTS (Not Applicable)

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. TAB contractor shall conduct a site inspection with the mechanical contractor at least fourteen (14) days prior to beginning the testing and balancing effort to review project conditions and readiness. TAB contractor shall develop and submit a list of installation deficiencies that would preclude the TAB contractor from executing the TAB of systems and equipment. This list shall be submitted to the mechanical engineer and the mechanical contractor for review. The mechanical contractor shall address and correct these deficiencies.
- C. An onsite coordination meeting with the mechanical engineer, mechanical contractor, TAB contractor, and temperature control contractor shall take place at least five (5) days prior to beginning the testing and balancing efforts.
- D. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- E. Examine the approved submittals for HVAC systems and equipment.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- G. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- H. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- I. Examine test reports specified in individual system and equipment Sections.
- J. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

- L. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- M. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- O. Examine system pumps to ensure absence of entrained air in the suction piping.
- P. Examine operating safety interlocks and controls on HVAC equipment.
- Q. 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 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures, draft test reports reflecting design conditions of equipment, terminal units, and terminal outlets and inlets, and submit to the mechanical engineer.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 TEMPERATURE CONTROLS

- A. Inspect all temperature control systems for proper sequence of operation, completeness and approximate calibration. Report any deficiencies to the mechanical contractor and temperature control contractor.
- B. TAB Contractor shall coordinate balancing of the system with the Temperature Controls Contractor prior to start of Testing and Balancing to coordinate use of Temperature Control System and Technicians.
- C. All balancing shall be performed, coordinated, and scheduled with the Temperature Controls Contractor. Refer to Specification Section 23 09 93 for additional requirements.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. For variable-air-volume systems, develop a plan to simulate diversity.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, roof-top unit, and other air handling and treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 5. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 6. 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 mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set 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 the 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 maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 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.
 8. Record final fan-performance data.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
1. Open all manual valves for maximum flow.
 2. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 3. Set system controls so automatic valves are wide open to coils.
 4. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

- B. Select the hydronic coil that is most critical to the distribution system. Adjust the system static pressure by varying the pump's respective variable frequency drive so the pressure differential across the critical coil assembly satisfies the coil's required flow rate. Record the variable frequency drive value and the respective pressure and communicate these values to the temperature control's contractor to establish the system's operating parameters for the temperature control system.

3.10 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.11 PROCEDURES FOR EXISTING PENTHOUSE AIR HANDLER AHU-2

- A. Stage 1 – Pre-Air Flow Measurement:
 - 1. Index all associated existing VAV terminal units to 100% cooling set-point.
 - a. There are twenty-eight (28) existing VAV terminal units associated with existing air handler AHU-2.
 - 2. Measure and Record Supply Air and Return airflow values at AHU-2.
 - 3. Record the setting for supply-air, static-pressure controller.
 - 4. Measure and Record Supply Air and Return air fans' horsepower, rated amperage, load amperage, fan speed, and static pressure.
 - 5. Report values to the Engineer.
- B. Stage 2 – Post-Air Flow Measurement:
 - 1. Index all associated existing and new VAV terminal units to 100% cooling set-point.
 - a. There are thirty (30) existing and new VAV terminal units associated with existing air handler AHU-2.
 - 2. Measure and Record Supply Air and Return airflow values at AHU-2.
 - 3. Setting for supply-air, static-pressure controller.
 - 4. Measure and Record Supply Air and Return air fans' horsepower, rated amperage, load amperage, fan speed, and static pressure.
 - 5. Report values to the Engineer

3.12 PROCEDURES FOR VAV REHEAT COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Data shall be obtained with the airflow rate and entering air and water temperatures near the scheduled entering conditions.
 - 2. Entering- and leaving-water temperature.
 - 3. Water flow rate.
 - 4. Water pressure drop.
 - 5. Dry-bulb temperature of entering and leaving air as displayed on the Building Management System.
 - 6. Airflow rate as displayed on the Building Management System.
 - 7. Coils fitted with autoflow valves record the following:
 - a. The valve manufacture's tagged and labeled data.
 - b. The pressure drop across the valve.

3.13 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
 - 2. Air Outlets and Inlets: Plus or minus 5 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 5 percent.

3.14 REPORTING

- A. Status Reports: Report a list of deficiencies and problems found in systems being tested and balanced to the Engineer.

3.15 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. Settings for supply-air, static-pressure controller.
 - f. Other system operating conditions that affect performance.

3.16 ADDITIONAL TESTS

- A. Warranty: if there are any space temperatures or equipment not meeting design parameters then the TAB firm shall perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. The TAB Contractor shall include, after completing and submitting the final report, one (1) day of follow-up testing within the project's warranty period to make any Owner or Engineer directed balance changes or modifications.

END OF SECTION 230593

SECTION 230700 – HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Mineral-fiber blanket insulation.
 - b. Mineral-Fiber pipe insulation.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Sealants.
 - 6. Factory-applied jackets.
 - 7. Field-applied jackets.
 - 8. Tapes.
 - 9. Securements.
 - 10. Corner angles.
- B. Related Sections:
 - 1. Division 23 Section "Metal Ducts" for duct liners.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- G. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.

- e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: Aluminum.
 - 6. For indoor applications, 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).
- B. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.
 - 6. For indoor applications, 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).

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: White.
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 - 5. Factory-fabricated tank heads and tank side panels.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
- B. Insulation Pins and Hangers:
1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

- c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

2.10 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. 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.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- E. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- E. Install insulation to flanges as specified for flange insulation application.
- F. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FINISHES

- A. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two location(s) for each duct system.
 2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two location(s) for each type of equipment. For large equipment, remove only a portion adequate to determine compliance.

3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, two locations of threaded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

- A. Items Not Insulated:
 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums and casings.
 4. Flexible connectors.
 5. Vibration-control devices.
 6. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Heating-Hot-Water Supply and Return, 200 Deg F and below: Insulation shall be the following:
 1. Mineral-Fiber, Preformed Pipe, Type I: 1-inch thick for piping 1-1/2" and smaller and 2" thick for piping 2" and larger.

END OF SECTION 230700

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Approved temperature control contractors subject to compliance with the contract documents:
 - 1. Long Building Technologies.
- B. A new web-based accessible, Direct Digital Control (DDC) temperature control system using BACnet communication protocol shall be provided for this remodel project.
- C. All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.
- D. BMS Contractor shall provide a complete system and shall include interfacing into the existing school's local BMS network and the District's central Tridium Supervisor AX front-end system to permit monitoring and adjustment of the new controls installed in this project.
- E. The BMS contractor shall refer to all plans and specifications for further instructions, details, and requirements not listed in this specification.
- F. The BMS contractor shall coordinate demolition of the existing instrumentation and controls associated with the mechanical and plumbing equipment and system demolition shown and further described on the respective mechanical and plumbing drawings.
- G. This Section includes control equipment for the new HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- H. See Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.
- I. See Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for requirements that relate to this Section.

1.2 DEFINITIONS

- A. Standard
 - 1. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers
 - 2. AHU: Air Handling Unit
 - 3. BACnet: Building Automation Controls Network
 - 4. BMS: Building Management System
 - 5. DDC: Direct Digital Control
 - 6. EIA: Electronic Industries Alliance
 - 7. GUI: Graphical User Interface

8. HVAC: Heating, Ventilation, and Air Conditioning
 9. IEEE: Institute Electrical Electronic Engineers
 10. MER: Mechanical Equipment Room
 11. PID: Proportional, Integral, Derivative
 12. VAV: Variable Air Volume Box
- B. Communications and protocols
1. ARP: Address Resolution Protocol
 2. CORBA: Common Object Request Broker Architecture
 3. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
 4. DDE: Dynamic Data Exchange
 5. HTTP: Hyper Text Transfer Protocol
 6. IIOP: Internet Inter-ORB Protocol
 7. LAN: Local Area Network
 8. MS/TP: Master Slave Token Passing
 9. ODBC: Open DataBase Connectivity
 10. ORB: Object Request Broker
 11. SQL: Structured Query Language
 12. UDP: User Datagram Protocol
 13. XML: eXtensible Markup Language
- C. Controllers
1. AAC: Advanced Application Controller
 2. UEC: Unitary Equipment Controller
 3. UNC: Universal Network Controller
 4. VAVDDC: Variable Air Volume Direct Digital Controller
- 1.3 SYSTEM DESCRIPTION Ethernet (IEEE 802.3), peer-to-peer CSMA/CD
- A. Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing a high speed peer to peer network of interoperable Direct Digital Controls (DDC), Graphical User Interface (GUI) with color graphic displays available on at least 64 client computers, and electronic interfaces and actuation devices, as shown on the drawings and as described herein.
 - B. BMS Contractor shall provide a complete system and shall include interfacing into the existing school's local BMS network and the District's central Tridium Supervisor AX front-end system to permit monitoring and adjustment of the new controls installed in this project
 - C. The Local Area Network (LAN) shall be either a 10 or 100 Mbps Ethernet network supporting BACnet, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Universal Network Controllers (UNCs), user workstations and a local host computer system.
 - D. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.

- E. The system will consist of an architecture that utilizes a MS/TP selectable 9.6-76.8 K9600 Baud protocol, as the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135-2001, BACnet functionality to assure interoperability between all system components. The AAC shall be capable of communicating as a MS/TP device or as a BACnet IP device communicating at 10/100 Mbps on a TCP/IP trunk. The AAC shall have a MS/TP bus that is capable of supporting up to 127 UEC's or VAVDDC's without the addition of repeaters. The ANSI / ASHRAE™ Standard 135-2001, BACnet protocol are required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.
- F. The software tools required to network manage the ANSI / ASHRAE™ Standard 135-2001, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, that are required to meet the functional intent, shall be provided without additional cost to the Owner. Minimum BACnet compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet/Ethernet IP or MS/TP.
- G. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein.
 - 1. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs.
 - 2. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage.
 - a. This data shall reside on a supplier-installed server for all database access.
 - b. Systems requiring proprietary database and user interface programs shall not be acceptable.
 - c. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network.
 - d. Systems employing a "flat" single tiered architecture shall not be acceptable.
- H. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the ABS Control Contractors. The BMS Control Contractors shall have a minimum of 5 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer when requested. Supervision, hardware and software engineering, calibration and checkout of the system shall be by the employees of the BMS Control Contractors and shall not be subcontracted. The control contractor shall have an in place support facility within 200 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system, and the control contractor shall have 24 hours/day, 7 days/week emergency service available.
- I. UPS (uninterruptible power supply) shall be installed at each control panel. Size for 25% spare capacity with sufficient capacity to allow emergency power for a minimum of 15-minutes.

1.4 INSTALLATION OF PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION (Unless noted otherwise on the Drawings).

- A. Hydronic Piping:
 - 1. Control Valves.
 - 2. Temperature Sensor Wells and Sockets.

1.5 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION (Unless otherwise noted on the Drawings).

- A. None:

1.6 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION (Unless otherwise noted on the Drawings).

- A. VAV Terminal Units

1.7 SUBMITTALS.

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. Each control device labeled with setting or adjustable range of control.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, and method of field assembly, components, and location and size of each field connection.
 - 1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Details of control panel faces, including controls, instruments, and labeling.
 - 4. Written description of sequence of operation.
 - 5. DDC System hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
 - 6. Control System Software: Schematic diagrams, written descriptions, and points list.
 - 7. Schedule of valves including close-off and flow characteristics.
 - 8. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 - 9. Listing of connected data points, including connected control unit and input device.
 - 10. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 - 11. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
- C. PIC/BIBB statement clarifying which BACnet objects and services are supported by each controller.

- D. ANSI / ASHRAE™ Standard 135-2001, BACnet PIC/BIBB Statement: Proof of Compliance Level 3 or higher is required to protect building owner by reducing future maintenance and expansion costs.
- E. Software and Firmware Operational Documentation: Include the following:
 - 1. Engineering, Installation, Operation and Maintenance manuals.
 - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Licenses, guarantee, and warranty documents for all equipment and systems.
- F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- H. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.8 RECORD DOCUMENTATION:

- A. Operation and Maintenance Manuals
 - 1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BMS provided:
 - a. Table of contents.
 - b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - c. Manufacturer's product data sheets or catalog pages for all products including software.
 - d. System Operator's manuals.
 - e. Archive copy of all site-specific databases and sequences.
 - f. BMS network diagrams.
 - g. Interfaces to all third-party products and work by other trades.
 - 2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

1.9 QUALITY ASSURANCE.

- A. Bids by wholesalers, distributors, mechanical contractors, ABCS, ACS, and non-franchised contractors shall not be acceptable.

- B. The system manufacturer shall, as a minimum, manufacture and supply the Variable Air Volume Direct Digital Controller, Network Controller, Unitary Equipment Controller, Advanced Application Controller, Graphical User Interface, damper actuators, and valve actuator assemblies.
- C. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer's local field office.
- D. The Building Management System contractor shall have a full service facility within 200 miles of the project that is staffed with engineers trained in Integrating Interoperable Systems and technicians fully capable of providing routine emergency maintenance service on all system components.
- 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 NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- G. Comply with National Electric Code, UL-916 Energy Management Systems, ULC, FCC Part 15, subpart J, Class B Computing Devices.

1.10 DELIVERY, STORAGE AND HANDLING.

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.11 COORDINATION.

- A. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor Control Centers," "Panelboards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.
- C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- D. Coordinate with the Owner's IT department on locations for UNC's, Ethernet communication cabling and TCP/IP addresses.
- E. Coordinate and provide the project's mechanical engineer remote web based access for system performance monitoring purposes. Coordinate access security level with the Owner.

1.12 WARRANTY AND MAINTENANCE.

- A. All components, system software, and parts furnished and installed by the BMS contractor shall be guaranteed against defects in materials and workmanship for 1 year of substantial completion. Labor to repair, reprogram, or replace these components shall be furnished by the BMS contractor at no charge during normal working hours during the warranty period. Materials furnished but not installed by the BMS contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 standard working hours.
- B. Maintain an adequate supply of materials within 200 miles of the Project site such that replacement of key parts and labor support, including programming.
- C. During the warranty period, if system or equipment issues arise, the Contractor shall submit a warranty report to the Architect/Engineer identifying the issue and what was done to correct the issue. The warranty report shall identify the date the issue was discovered, when the issue was resolved, and the key personal involved in resolving the issue.

1.13 OWNERSHIP OF PROPRIETARY MATERIAL.

- A. The owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. All project developed software and documentation shall become the property of the owner. These include, but are not limited to project graphic images, record drawings, project database, project specific application programming code, and all other associated documentation.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
 - 1. Electric Components
 - a. Distech Controls
 - 2. Electronic Components
 - a. Tridium and Distech Controls
 - 3. Direct Digital Control Systems and Approved Installing Contractors:
 - a. Tridium and Distech Controls installed by Long Technologies.

2.2 DDC EQUIPMENT

- A. UPS (uninterruptible power supply) shall be installed at each control panel. Size for 25% spare capacity with sufficient capacity to allow emergency power for a minimum of 15-minutes.
- B. Control Units General:
 - 1. Provide an adequate number of control units to achieve monitoring and control of all data points specified and necessary to satisfy the sequence of operation for all mechanical systems shown on the plans. Provide a minimum of one separate controller for each AHU or other HVAC system. Multiple DDC controllers may control one system provided that all points associated with individual control loops are assigned to the same DDC controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement. Each of the following panel types shall meet the following requirements.
 - 2. Controllers shall be suitable for the anticipated ambient conditions.
 - a. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40°F to 140°F and 5 to 95% RH, non-condensing.
 - b. Controllers used in conditioned ambient space shall be mounted in dustproof enclosures, and shall be rated for operation at 32°F to 122°F and 5 to 95% RH, non-condensing.
 - 3. Serviceability: Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
 - 4. Memory: The Control Units shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
 - 5. Diagnostics: The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode and generate an alarm notification.
 - 6. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 ft.
 - 7. Automatic staggered restart of field equipment after restoration of power and short cycle protection.
- C. Universal Network Controllers (UNC)
 - 1. The Universal Network Controllers (UNC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the UNC. It shall be capable of executing application control programs to provide:
 - a. Calendar functions
 - b. Scheduling
 - c. Trending
 - d. Alarm monitoring and routing
 - e. Time synchronization by means of an Atomic Clock Internet site including automatic synchronization
 - 2. The Universal Network Controller Type 1 must provide the following hardware features as a minimum:

- a. One Ethernet Port – 10/100 Mbps
- b. Two RS-232 ports
- c. Two RS-RS485 ports electrically isolated
- d. One LonWorks Interface Port – 78KB FTT-10A with Weidmuller connector
- e. Power supply 24 VAC or 24 VDC
- f. Battery Backup
- g. Real-time clock
- h. Processor @ 200 MHz or greater
- i. Java Virtual Machine
- j. 40 Mb flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
- k. 128 Mb Ram or greater
3. The UNC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the UNC shall be an ODBC compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
4. The UNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 64 simultaneous users.
5. Event Alarm Notification and actions
 - a. The UNC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 - b. The UNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
 - c. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - 1) To alarm
 - 2) Return to normal
 - 3) To fault
 - d. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
 - e. Provide timed (schedule) routing of alarms by class, object, group, or node.
 - f. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
 - g. Control equipment and network failures shall be treated as alarms and annunciated.
 - h. Alarms shall be annunciated in any of the following manners as defined by the user:
 - 1) Screen message text
 - 2) Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a) Day of week
 - b) Time of day
 - c) Recipient
 - 3) Pagers via paging services that initiate a page on receipt of email message

- 4) Graphic with flashing alarm object(s)
 - 5) Printed message, routed directly to a dedicated alarm printer
- i. The following shall be recorded by the UNC for each alarm (at a minimum):
 - 1) Time and date
 - 2) Location (building, floor, zone, office number, etc.)
 - 3) Equipment (air handler #, accessway, etc.)
 - 4) Acknowledge time, date, and user who issued acknowledgement.
 - 5) Number of occurrences since last acknowledgement.
- j. Alarm actions may be initiated by user-defined programmable objects created for that purpose.
- k. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- l. A log of all alarms shall be maintained by the UNC and/or a server (if configured in the system) and shall be available for review by the user.
- m. Provide a "query" feature to allow review of specific alarms by user defined parameters.
- n. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
- o. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.
6. Data Collection and Storage
 - a. The UNC shall have the ability to collect data for any property of any object and store this data for future use.
 - b. The data collection shall be performed by log objects, resident in the UNC that shall have, at a minimum, the following configurable properties:
 - 1) Designating the log as interval or deviation.
 - 2) For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 - 3) For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 - 4) For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
 - 5) Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
7. All log data shall be stored in a relational database in the UNC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
8. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
9. All log data shall be available to the user in the following data formats:
 - a. HTML
 - b. XML
 - c. Plain Text

- d. Comma or tab separated values
- 10. Systems that do not provide log data in HTML and XML formats at a minimum shall provide as an alternative Microsoft SQL Server®, Oracle 8i or Express®, Hyperion Solutions™ SQL Server.
- 11. The UNC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other UNC on the network. Provide the ability to configure the following archiving properties, at a minimum:
 - a. Archive on time of day
 - b. Archive on user-defined number of data stores in the log (buffer size)
 - c. Archive when log has reached it's user-defined capacity of data stores
 - d. Provide ability to clear logs once archived
- 12. AUDIT LOG
 - a. Provide and maintain an Audit Log that tracks all activities performed on the UNC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the UNC), to another UNC on the network, or to a server. For each log entry, provide the following data:
 - 1) Time and date
 - 2) User ID
 - 3) Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
- 13. DATABASE BACKUP AND STORAGE
 - a. The UNC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
 - b. Copies of the current database and, at the most recently saved database shall be stored in the UNC. The age of the most recently saved database is dependent on the user-defined database save interval.
 - c. The UNC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.
- D. Advanced Application Controller (AAC):
 - 1. Modular, comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control applications. AAC's shall be provided for large AHU's, Boiler Plant, Chiller Plant and other applications.
 - 2. Units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, Boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, enthalpy calculation, counters, interlocks, ramps, drivers, schedules, calendars, OSS, compare, limit, curve fit, and alarms.
 - 3. The Advanced Application Controller shall have the following point count as a minimum.
 - a. 4 Digital Inputs.
 - 1) 10 pulses per second.

- b. 12 Universal Inputs
 - 1) 0-20mA
 - 2) 0-5 VDC
 - 3) Balco Sensors
 - 4) Platinum Sensor
 - 5) 10K thermistor
- c. 8 Universal Outputs
 - 1) 0-20 mA
 - 2) 12 VDC relay driver
 - 3) Individually short circuit protected
 - 4) LED indication
- d. 8 Digital Outputs
 - 1) Triacs
 - 2) LED indication
- 4. The controller shall come with an on board regulated 20 VDC power supply rated at 100 mA.
- 5. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Peer to peer primary network level communications supporting BACnet objects and services according to PIC and BIBBs statement.
 - b. Automatic communications loss detection to maintain normal control functionality regardless of available networks communications.
 - c. Discrete/digital, analog, and pulse input/outputs.
 - d. Monitoring, controlling, or addressing data points.
 - e. Local energy management control strategies
 - f. Incorporate internal customizable safeties and limits to prevent third party BACnet tools from providing improper and unrealistic inputs to AAC's.
- 6. Local operator interface port provides for download from and connection to portable workstation.
- 7. Communication:
 - a. The Advanced Application Controller shall communicate via the Primary Controller Network between BMS Controllers and other BACnet devices.
 - b. Communication shall be peer-peer.
 - c. AAC's shall communicate with and other BACnet devices at a baud rate selectable between 9.6 and 76.8 Kbaud using MS/TP communications protocol.
 - d. AAC shall communicate with the UNC using:
 - 1) RS-485 trunk with a baud rate selectable between 9.6 and 76.8 Kbaud using MSTP communications protocol.
 - 2) A Ethernet trunk 10/100 Mb using BACnet IP.

E. Unitary Equipment Controller Units:

1. Single board construction comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control and unitary applications. UECs shall be provided for Unit Ventilators, Fan Coils, Heat Pumps, Rooftop Units, and other applications as shown on the drawings. To assure complete interoperability, all UEC's firmware shall support all BACnet objects and services as called out in the PIC and BIBBs statement
2. The Unitary Equipment Controller shall have the following point count as a minimum.
 - a. 6 Universal Inputs
 - 1) 0-20mA
 - 2) 0-5 VDC
 - 3) Balco Sensors
 - 4) Platinum Sensor
 - 5) 10K thermistor
 - b. 4 Analog Outputs
 - 1) 0-20 mA
 - 2) 0-5/10 VDC
 - 3) Individually short circuit protected
 - c. 8 Digital Outputs
 - 1) Triacs
 - 2) LED indication
3. Units monitor or control each input/output point; process information; and download from the operator station.
4. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Peer to peer primary network level communications with automatic communications loss detection to maintain normal control functionality regardless of available network communications.
 - b. Discrete/digital, analog, and pulse input/output.
 - c. Monitoring, controlling, or addressing data points.
 - d. Appropriate BACnet Objects for specific unitary applications.
5. Local operator interface port located on UEC and UEC sensor provides for download from or upload to portable workstation. All bus devices shall be accessible from either port.
6. Communication: UEC's shall communicate with the UNC and ACC at a baud rate selectable of 9.6-76.8 Kbaud utilizing MS/TP.
7. UEC units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, Boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, counters, interlocks, compare, limit, and alarms.
8. All UEC Controller setpoints shall be digital display setpoints with dual setpoint limits (integral hard limits which the user cannot exceed above and below and independent soft limits which are hidden from the user). All digital setpoints shall be network retentive after power outages and after replacement of sensor.

F. UEC Room Sensor

1. The UEC Sensor shall provide room temperature value to the UEC.
2. Each UEC will support a minimum of two room sensors.
3. The UEC Sensor shall connect directly to the ASC and shall not utilize any of the I/O points of the controller.
4. The UEC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive.
5. The UEC Sensor shall provide a communications jack for connection to the MS/TP communication trunk to which the UEC controller is connected.
6. The UEC Sensor, the connected controller, and all other devices on the MS/TP bus shall be accessible by the Portable Engineering Station.
7. The UEC Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
8. The UEC Sensor shall allow for the customization of the color on the esthetic covering as a standard offering.
9. The UEC Sensor shall be supplied in the following manner:
 - a. LCD display for showing (typically) the current temperature.
 - b. Tenant override to allow timed override of unoccupied to occupied mode of operation.
 - c. LED indication of override state
 - d. Up/Down keys to allow adjustment of the current setpoint
 - e. User interface with the UEC Sensor shall be provided as a configurable function, and shall offer password protection for access to network variable editing.
 - f. ASHRAE 95 compliance (LCD display and sub-base functionality)
 - g. The room sensor shall provide access to additional diagnostic data from a sensor-user keypad request. This Diagnostic mode is displayed on the LCD screens and includes separate displays for the controllers:
 - 1) Subnet and Node Address
 - 2) Errors
 - 3) Alarms
 - 4) Temperature Offset

G. VAV Controller Functionality (VAVDDC).

1. Controls shall be microprocessor based Pressure Independent Variable Air Volume Digital Controllers, as shown in the drawings. The VAVDDC shall be a single integrated package consisting of a microprocessor, power supply, damper actuator, differential pressure transducer, field terminations, and application software. All input/output signals shall be directly hardwired to the VAVDDC controller. The internal actuator shall employ a manual override that allows for powered or non-powered adjustment of the damper position. In all cases, the controller shall automatically resume proper operation following the return of power to, or control by the ASC. Programming, configuring and/or troubleshooting of input/output signals shall be easily executed through the ASC sensor or GP tool connected at the wall sensor location.
2. Shall provide BACnet object and service support to provide BAS integration and optimum use of network bandwidth,
3. The VAVDDC control algorithms shall be designed to limit the frequency of damper repositioning, to assure a minimum 10-year life from all components. The VAVDDC shall provide internal differential pressure transducer for pressure independent applications with an accuracy of $\pm 5\%$. Flow through transducers requiring filter maintenance are not acceptable. The VAVDDC shall provide zone control accuracy equal to or better than ± 1

degree F. Systems providing control accuracies greater than +/- 1 degree F are not acceptable. With the submittal package, contractor shall provide performance data that verifies control accuracy of the VAVDDC.

4. All input/output signals shall be directly hardwired to the VAVDDC. A minimum of three input points of the VAVDDC shall employ a universal configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current sourced inputs. If three universal points are not available, a minimum of three input points (each) of the dry contact, resistive and analog voltage/current types must be Triac and universal analog form. All digital outputs shall be Triac type. Devices utilizing non-relay outputs shall provide an interface relay for all points. All analog outputs shall be programmable for their start points and span to accommodate the control devices. Configuration of all I/O points shall be accomplished without physical hardware jumpers, switches or settings. Troubleshooting of input/output signals shall be easily executed with the Graphical Programming tool or a volt-ohm meter (VOM). All I/O points shall be utilized by the local ASC or shall be available as I/O points for other controllers throughout the network.
5. The BMS contractor shall field install the VAVDDC to the VAV box.
6. The VAV terminal manufacturer shall provide a multi-point, averaging, differential pressure sensor mounted on the inlet to each VAV box. The BMS contractor shall provide all reheat control valves to the mechanical contractor for mounting and piping. The FMCS contractor shall provide and install the VAV box discharge air temperature sensor and all wiring between the discharge air temperature sensor and the VAVDDC controller, the valve and VAVDDC controller and between the room sensor and the VAVDDC controller.

H. VAV Box Room Sensor

1. The VAV Box Room Sensor shall provide room temperature value to the controller.
2. The VAV Box Room Sensor shall connect directly to the controller Box and shall not utilize any of the I/O points of the controller.
3. The VAV Box Room Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive.
4. The VAV Box Room Sensor shall provide a communications jack for connection to the native BACnet RS-485 communication trunk to which the ASC controller is connected.
5. The VAV Box Room Sensor, the connected controller, and all other devices on the LON bus shall be accessible by the Portable Engineering Station.
6. The VAV Box Room Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
7. The VAV Box Room Sensor shall allow for the customization of the color on the esthetic covering as a standard offering.
8. The VAV Box Room Sensor shall be supplied in the following manner:
 - a. LCD display for showing the current temperature.
 - b. Tenant override to allow timed override of unoccupied to occupied mode of operation.
 - c. LED indication of override state
 - d. Up/Down keys to allow adjustment of the current setpoint
 - e. User interface with the VAV Box Sensor shall be provided as a configurable function, and shall offer password protection for access to network variable editing.
 - f. ASHRAE 95 compliance (LCD display and sub-base functionality)
 - g. The VAV Box Room Sensor shall provide access to additional diagnostic data from a sensor-user keypad request. This Diagnostic mode is displayed on the LCD screens and includes separate displays for the controllers:

- 1) Subnet and Node Address
- 2) Errors
- 3) Alarms
- 4) Temperature Offset

h. Room sensor accessories include the following:

- 1) Insulating Bases: For sensors located on exterior walls.
 - 2) Sensor Guards: Where shown on the drawings.
 - 3) Adjusting Key: As required for calibration and cover screws.
9. Provide and install a manual ventilation control switch in each laboratory as outlined on the mechanical drawings to override the VAV setpoints for each mode of operation (standard classroom airflow rates vs laboratory airflow rates) listed in the sequence of operations.

I. VAVDDC –Air Balancing.

1. Through a BACnet Portable Engineering Station or the Configuration Commissioning Diagnostic Tool furnished by the BMS contractor, the VAVDDC shall support a fully prompted Air Balance sequence. The BPES or CCDT shall, when connected through the wall sensor on the Ethernet network or through a WiFi connection access the VAVDDC unit. The air balance sequence shall step the balancing contractor through the checkout and calibration of the VAVDDC. Upon completion of the balancing sequence, the flow values presented by the VAVDDC shall match those observed by the balancing contractor's measurement equipment. Additionally, upon completion of the air balance, the balance settings shall be archived for future in the VAVDDC. The CCDT shall be able to access these balance settings at any time and generate a report. The balance settings can be uploaded by either the BPES or CCDT for use if the VAVDDC requires replacement. Systems not able to provide a formatted air balance Graphical Programming Tool shall provide an individual full time during the Air-balancing process to assure full balance compliance.

J. LANs:

1. Capacity for a minimum of 64 client workstations connected to multi-user, multitasking environment with concurrent capability to access DDC network or control units.
2. Enterprise Network LAN
 - a. Media: Ethernet (IEEE 802.3), peer-to-peer CSMA/CD, operating at 10 or 100 Mbps, cable 10 Base-T, UTP-8 wire, category 5
3. Primary Controller Network LAN
4. Remote Connection
 - a. Static IP address provided by Owner's Representative for system viewing on the LAN.
 - b. Available based on Owner's Security Settings and Network Administration requirements for VPN, etc. for outside access to network.

K. Software:

1. Provide the necessary means to integrate the most current operating software with the District's existing front-end temperature systems and servers. Contractor shall work with the District's IT personal as necessary to implement and use the most current operating software available for the temperature control system.
2. Controller and System HVAC Applications

- a. Update to latest version of software at Project completion. Include and implement the following capabilities from the control units if documented by the specified sequence of operations:
 - 1) Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, occupied/unoccupied setback/setup, DDC with PID, and trend logging.
 - 2) HVAC Control Programs: Optimal run time, supply-air reset and system volume totaling, outdoor air damper control based on mixed air temperature calculation, and enthalpy/economizer switchover.
 - 3) Chiller Control Programs: Chilled water plant optimization with chilled-water reset, chiller and pump equipment selection and sequencing.
 - 4) Boiler Control Programs: Building loop heating hot water optimization with hot water supply reset, pump equipment selection and sequencing.
 - 5) Programming Application Features: Include trend point, alarm reporting, alarm lockout, weekly scheduling, staggered start, sequencing, anti-short cycling and calculated point.

2.3 CONTROL PANELS

- A. Local Control Panels: Unitized NEMA 1 cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
 1. Fabricate panels of 0.06-inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
 2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
 3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.
 4. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.

2.4 SENSORS

- A. Electronic Temperature Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
 1. Resistance Temperature Detectors: Platinum, thermistor, or Balco
 - a. Accuracy: Plus or minus 0.2 percent at calibration point; thermistors shall have a maximum 5 year drift of no more than .225°F maximum error of no more than .36°F
 - b. Wire: Twisted, shielded-pair cable
 - c. Insertion Elements in Ducts: Single point, 6 inches long; use where not affected by temperature stratification or where ducts are smaller than 4 sq. ft.

- d. Averaging Elements in Ducts: 60 inches, long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 264 inches long, flexible for use where prone to temperature stratification or where ducts are larger than 16 sq. ft; length as required.
 - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 - f. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- B. Static-Pressure Transmitter: Solid state, pressure transducer with suitable range for expected input, and temperature compensated.
- 1. Accuracy: +/- 1 percent of full scale with repeatability of 0.5 percent.
 - 2. Output: 4 to 20 mA, 0-5 vDC, 0-10 vDC.
 - 3. Building Static-Pressure Range: -.1 to .1, -0.25 to 0.25, -.5 to .5, -1.0 to 1.0 IN WC., jumper selectable.
 - 4. Duct Static-Pressure Range: 0 to 1, 0 to 2.5, 0 to 5, 0 to 10 IN WC., jumper adjustable
 - 5. Note: Static-pressure transmitters and outside air pressure pickup ports serving the buildings static pressure systems shall be coordinated and located to provide the least amount of tubing between the devices. Provide multiple outside air pressure pickup ports to reduce tubing lengths to pressure transmitters.
- C. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.
- D. Equipment operation sensors as follows:
- 1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 IN WC
 - 2. Status Inputs for Pumps: Differential-pressure switch piped across supply and return piping with adjustable pressure-differential range of 5 to 60 psig.
 - 3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- E. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- F. Water-Flow Switches: Pressure-flow switches of bellows actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless steel or bronze paddle. For chilled water applications, provide vapor proof type.
- G. Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23°F to 130°F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.

2.5 THERMOSTATS

- A. Room Temperature Sensor:
- 1. Communicating room sensor providing precise temperature.
 - 2. Dual connector ports for connection to field controller shall support both power and communication, with provision for "daisy-chain" connection, so that more than one

communicating sensor can be used with a single field controller. Dual connector ports shall be female RJ45 and shall be compatible with standard Ethernet pinout T568B.

3. Temperature Sensor:
 - a. Range: 41 deg F to 104 deg F.
 - b. Accuracy: 0.9 deg F.
 - c. Resolution: 0.18 deg F.
 - d. LED Indication for set-point offset: only in occupied type spaces; i.e. classrooms, offices, breakroom, conference rooms, media rooms, and other similar type rooms.
 - e. LED Indicator only: for corridors, vestibule, multipurpose, and other similar type rooms.
 4. Enclosure: NEMA-1
 5. Refer to the mechanical drawings for additional configuration requirements.
 6. Provide thermostat guards where noted or shown on the mechanical drawings.
- B. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- C. Electric High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

2.6 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action under all environmental conditions (temperature, low power voltage fluctuations, tight seal damper design, maximum air and water flow forces).
1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 3. Spring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running and breakaway torque of 150 in. x lbf.
 4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Damper and Valve Actuators: Direct-coupled type non hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. The actuator shall have rating of not less than twice the thrust needed for actual operation of the damper or valve
1. Coupling: V-bolt and V-shaped, toothed cradle.
 2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

3. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
4. Actuators shall have the ability to be tandem mounted.
5. All spring-return actuators shall have a manual override. Complete manual override shall take no more than 10 turns.
6. Power Requirements (Two-Position Spring Return): 24V ac or dc, Maximum 10VA.
7. Power Requirements (Modulating): Maximum 15 VA at 24V ac.
8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
9. Temperature Rating: -22°F to 140°F.
10. Run Time: 200 seconds open, 40 seconds closed.
11. All actuators shall have a 5 year warranty
12. Valves:
 - a. Size for torque required for valve close-off at maximum pump differential pressure (regardless of water loop system pressures).
 - b. Valve and Actuators shall come from the factory fully assembled.
 - c. Spring Return Manual Override shall come with a 10 Degree Valve Preload to assure tight close off.
 - d. Proportional Signal Type:
 - 1) All air handling coils.
 - e. Floating Signal Type:
 - 1) All VAV reheat coils.
 - f. Two-Position Type:
 - 1) All fan coils and unit heaters.
13. Dampers:
 - a. Size for running torque calculated as follows:
 - 1) Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.
 - 2) Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
 - 3) Parallel-Blade Damper without Edge Seals: 4 inch-pounds/sq. ft. damper.
 - 4) Opposed-Blade Damper without Edge Seals: 3 inch-pounds/sq. ft. of damper.
 - 5) Dampers with 2 to 3 Inches wg. of Pressure Drop or Face Velocities of 1000 to 2500 FPM Multiply the minimum full-stroke cycles above by 1.5.
 - 6) Dampers with 3 to 4 Inches wg. of Pressure Drop or Face Velocities of 2500 to 3000 FPM Multiply the minimum full-stroke cycles above by 2.0.
 - b. Spring Return Manual Override actuators shall a factory set 5 Degree Damper Preload.

2.7 CONTROL VALVES

- A. Control Valves: Factory fabricated by Belimo, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Globe Valves NPS 2" and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure. Valves shall have allowable media temperature of 20°F to 280°F to assure that the valve packing will have a long life (valves will narrower allowable media temperatures have no reserve packing capability for long term watertight seal).
- C. Hydronic system globe valves shall have the following characteristics:
 - 1. Rating: Class 250 for service at 400 psig below 150°F operating conditions.
 - 2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
 - 3. Sizing: 3 psig. maximum pressure drop at design flow rate.
 - 4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.
- D. Terminal Unit Control Globe Valves: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure. Valves shall have allowable media temperature of 20°F to 280°F to assure that the valve packing will have a long life (valves will narrower allowable media temperatures have no reserve packing capability for long term watertight seal). Actuators shall be as noted above with 5 year warranty. Spring return is required for all terminal equipment that has an outside air source. All non-spring return valves must have manual override ability built in to the actuator.
 - 1. Rating: ANSI class 250, maximum static pressure of 400 psig below 150°F, minimum fluid temperature of 20°F and maximum of 280°F operating conditions.
 - 2. Sizing: 3 psig. maximum pressure drop at design flow rate, to close against pump shutoff head.
 - 3. Flow Characteristics: Two-way and three-valves shall have equal percentage characteristics.

2.8 CONTROL CABLE

- A. Electronic and Fiber-Optic Cable for Control Wiring: As specified in the Electrical Specifications.
- B. LON communication cable shall be category 4.
- C. All cabling exposed in the return air plenum shall be plenum rated.
- D. All control cabling shall be color coded. Coordinate cable color with the facility manager. Cable color shall not match the existing IT/Communication cabling color.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Contractor shall refer to the drawings and field investigate the existing conditions for locations of the existing temperature control equipment and distribution systems to be removed from this project.
- B. It is the intent that the existing temperature control systems associated with this project will be removed to support the extents of existing equipment and systems to be demolished on this project. Contractor shall note that there are existing temperature control systems not associated with this project which are interfaced with the existing temperature control systems which are serving systems and equipment on this project. These existing systems shall remain operational. Provide devices as required to keep these existing systems functional. Refer to the mechanical drawings for additional information.

3.2 EXAMINATION

- A. Verify that conditioned power supply is available to control units.

3.3 INSTALLATION

- A. Install equipment level and plumb.
- B. Install software in control units. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve sequence of operation specified.
- D. Verify location of room sensors, thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
 - 2. Install VAVDDC discharge air temperature sensors downstream of the reheat coil at a location of full air stream mixing and as recommended by the sensor manufacture.
- E. Install guards on sensors and thermostats where indicated on the drawings.
- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- G. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- H. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- I. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Contractor shall employ or contract with qualified electricians to perform the necessary electrical work to support the temperature control project.
- B. Install raceways, boxes, and cabinets according to the electrical specifications.
- C. Install building wire and cable according to the electrical specifications
- D. Install signal and communication cable according to the electrical specifications, and industry standards and codes.
 - 1. All exposed cabling installed in the plenum return areas shall be certified and rated for plenum applications.
 - 2. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 3. Install exposed cable in raceway.
 - 4. Install concealed cable in raceway.
 - 5. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 6. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 7. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 8. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- E. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- F. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.
- G. Install variable speed drives in accordance with the manufacturer's installation guidelines and requirements.
- H. Do not install control panels, variable frequency drives, starters or other electrical devices directly below fire sprinkler, plumbing or mechanical piping, coordinate installation of electrical devices with all trades and existing conditions.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing to the mechanical engineer.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.

3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 6. Test each system for compliance with sequence of operation.
 7. Test software and hardware interlocks.
- C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 2. Check instruments for proper location and accessibility.
 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 4. Check instrument tubing for proper fittings, slope, material, and support.
 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 6. Check temperature instruments and material and length of sensing elements.
 7. Check control valves. Verify that they are in correct direction.
 8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
 9. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Acceptance Check Sheet
1. Prepare a check sheet that includes all points for all functions of the temperature control system as indicated in the sequence of operations included in this project.
 2. Submit the check sheet to the Engineer for review and approval.
 3. The engineer will use the check sheet as the basis for acceptance with the temperature control contractor.
- E. VAVDDC box performance verification and documentation:
1. The temperature control contractor shall, in conjunction and coordination with Test and Balance contractor, test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
 2. The temperature control contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance.
 3. The temperature control contractor shall randomly test a minimum of 35% of the VAV boxes after approximately 6-months of operation and report the findings to the engineer.

The BMS Contractor shall contact the engineer prior to execution of this follow-up testing to obtain a list of VAV boxes to be tested.

- F. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.6 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one (1) year of date of Substantial Completion, provide up to one (1) project site visits, when requested by the Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.7 TRAINING

- A. On-site training shall be provided by a system technician who is fully knowledgeable of the specific installation details of the project. This training shall, at a minimum consist of the following:
1. Review and understanding of the project as-built temperature control drawings.
 2. Discussion and explanation of the HVAC sequence of operation.
 3. Review of the BMS software layout and naming conventions.
 4. A walk through of the facility to identify panel and device locations.
 5. Review of device and control trouble shooting.
 6. Proficiently operate the system.
 7. Understand control system architecture and configuration.
 8. Understand DDC system components.
 9. Understand system operation, including DDC system control and optimizing routines (algorithms).
 10. Log on and off the system.
 11. Access graphics, point reports, and logs.
 12. Adjust and change system set points, time schedules, and holiday schedules.
 13. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
 14. Understand Operation and Maintenance manual.
 15. Access data from DDC controllers
- B. Training duration shall consist of two (2) hours at substantial completion. Contractor shall coordinate scheduling of the training with the school district facility personnel. Contractor shall submit report, signed by authorized school district official, to the engineer documenting the completion of each training session.

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. See Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.
- C. See Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for coordination and collaboration with the TAB contractor during Test and Balance.
- D. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades.
- E. All work in this Division shall be coordinated and provided by a single Building Management System (BMS) Contractor.

1.2 NOTES

- A. All VAV terminal unit heat valves to fail in last position.
- B. All Temperature set points and reset schedules shall be adjustable.
- C. Provide independent set points for occupied and unoccupied modes.

1.3 SCOPE

- A. It is the intent of these specifications and the contract drawings to describe the work to be performed in order to provide a complete system of temperature controls including all materials, plans, labor and accessories necessary to the successful completion and operation of the system as intended.
- B. The work to be performed shall include but not necessarily be limited to the following systems and apparatus:
 - 1. Valves and actuators, dampers, control panels, gauges and instruments, direct digital system controls and sensors, electric wiring, and conduit.
- C. All packaged air handling units and other terminal units and equipment items noted in the sequence of operations shall be controlled by digital system controllers utilizing electronic actuators for the valves and dampers.
- D. Mechanical contractor and temperature control contractor to coordinate temperature control configuration and setup to meet the project's sequence of operations prior to bidding and

throughout the duration of construction. Refer to the sequence of operations in the latter part of this specification section.

- E. The BMS Contractor shall field install all digital VAV box controllers and actuators. BMS Contractor shall field coordinate the installation with the mechanical contractor.
- F. The temperature control contractor shall perform the demolition of the existing controls system serving equipment noted to be demo'd in the project. All existing temperature control lines, wiring, and devices serving equipment noted to be demo'd shall be removed.
- G. The temperature control contractor shall interface the new temperature control system with the existing building management systems and update the graphical user interface. User interface graphics shall match the graphics used in the existing building management system. Coordinate with the facility manager.
- H. Temperature Control Contractor shall calibrate all instrumentation and devices prior to substantial completion and after 8-months of system operation.

1.4 SCHEDULES

- A. Temperature Control Contractor shall establish all occupied, non-occupied, holiday, and summer schedules, and occupied and unoccupied (night setback) temperatures prior to final system commissioning. The temperature control contractor shall develop a schedule matrix worksheet and transmit to the owner for their input and development of the final schedule(s). The worksheet matrix shall, at a minimum list the following for each system and equipment:
 - 1. Equipment Tag and Description.
 - 2. Proposed Occupied Schedule
 - 3. Proposed Un-occupied Schedule
 - 4. Proposed Holiday Schedule
 - 5. Proposed Summer Schedule
 - 6. Proposed Occupied Space Temperatures
 - 7. Proposed Unoccupied (night setback) Space Temperatures
- B. Initial Space Temperature Set-Points (adjustable)
 - 1. Heating
 - a. Unoccupied: 65 F
 - b. Occupied: 72 F
 - 2. Cooling
 - a. Unoccupied: 80 F
 - b. Occupied: 75 F

1.5 SEQUENCE OF OPERATIONS

1.6 VAV BOX WITH HOT WATER REHEAT:

- A. Occupied Mode:

1. When the zone temperature is between the occupied heating and cooling set-points (inside of the bias), the primary air damper shall be at the scheduled Heating CFM position and the reheat valve shall be fully closed.
 2. On a rise in zone temperature above the cooling set-point, the primary air damper shall modulate further open to increase the air volume to the scheduled Cooling CFM and the reheat valve shall remain fully closed. Limit the maximum VAV damper position to the Cooling cfm value listed.
 3. On a drop in zone temperature below the space temperature heating set-point, the damper shall be commanded to its scheduled Heating CFM position and the reheat valve shall modulate to maintain the zone temperature heating set-point.
 - a. The discharge air temperature shall be limited to a maximum discharge air temperature of 120 F (adjustable). The control valve shall operate on a PID loop based on room temperature and set-point.
- B. Unoccupied (Night Setback) Mode:
1. When the respective air handler shuts down, all box controllers are indexed to unoccupied mode.
 2. When the zone temperature is between the unoccupied heating and cooling set-points (inside of the bias), the primary air damper shall go to the schedule "Minimum Unoccupied CFM" position, and the reheat valve shall be fully closed.
 3. On a rise in zone temperature above the cooling set-point, the primary air damper shall modulate further open to increase the air volume (if available) and the reheat valve shall remain fully closed.
 4. On a drop in zone temperature below the unoccupied heating set-point, the damper shall be commanded to its scheduled Heating CFM position and the reheat valve shall modulate to maintain the zone temperature unoccupied heating set-point.
 - a. The discharge air temperature shall be limited to a maximum discharge air temperature of 120 F (adjustable). The control valve shall operate on a PID loop based on room temperature and set-point.
- C. Monitor and Display
1. VAV air flow value
 2. VAV air flow set-points (minimum, heating, and cooling).
 3. Damper position.
 4. Reheat valve position.
 5. Inlet air temperature.
 6. Discharge air temperature.
 7. Zone Temperature.
 8. Zone Temperature Set-point (occupied and unoccupied).

1.7 EXHAUST EF-M6K

- A. No work by the Temperature Control Contractor associated with fan.
- B. Fan will be controlled by a pilot light timer switch located at the Teachers Station in Food Lab 100.

END OF SECTION 230993

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- 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.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.

2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

2.2 PIPING SPECIALTIES

- A. Y-Pattern Strainers:
 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 and smaller.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- B. Appliance Flexible Connectors:
 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 3. Corrugated stainless-steel tubing with polymer coating.
 4. Operating-Pressure Rating: 0.5 psig.
 5. End Fittings: Zinc-coated steel.
 6. Threaded Ends: Comply with ASME B1.20.1.
 7. Maximum Length: 18 inches.
- C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. Valves shall be listed and labeled for natural gas.
- C. General Requirements for Metallic Valves, NPS 3 and Smaller: Comply with ASME B16.33.
 1. CWP Rating: 125 psig.

2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Service Mark: Valves 1-1/4 inches to NPS 3 shall have initials "WOG" permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Perfection Corporation; a subsidiary of American Meter Company.
 2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Eccentric Plug Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. SMG Valves
 2. Description: Key Port Series 400
 3. Body: Cast Iron.
 4. Plug: Bronze or cast iron.
 5. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 6. Operator: Square head or lug type with tamperproof feature where indicated.
 7. Pressure Class: 125 psig.
 8. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded or socket.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 Emergency Gas Shutoff Valves:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Asco.
- B. Description: As outlined on the plumbing drawings.
- C. End Connections: Threaded for regulators NPS 4 and smaller

2.6 DIELECTRIC UNIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. McDonald, A. Y. Mfg. Co.
 2. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 3. Wilkins; Zurn Plumbing Products Group.
- B. Minimum Operating-Pressure Rating: 150 psig.
- C. Combination fitting of copper alloy and ferrous materials.
- D. Insulating materials suitable for natural gas.
- E. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.7 SLEEVES

- 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.

PART 3 - EXECUTION

3.1 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- L. Verify final equipment locations for roughing-in.
- M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- N. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

3.2 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- C. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.

3.3 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. 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.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Swivel ban or adjustable steel hangers for individual horizontal piping 1-1/2 NPS or less.
 - 3. Adjustable steel clevis hangers for individual horizontal piping 2 NPS or greater.
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
- D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 - 3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch

3.5 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.6 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.7 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.8 INDOOR PIPING SCHEDULE

- A. Aboveground, piping NPS 3" and smaller shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.

3.9 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Distribution piping valves for pipe sizes NPS 3 and smaller shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
- B. Valves in branch piping for single appliance shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping and fittings.
 - 2. Air-vent piping.
 - 3. Safety-valve-inlet and -outlet piping.
- B. See Division 23 section "Water Treatment" for the chemical treatment requirements.

1.2 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Hot-Water Heating Piping: 150 psig at 240 deg F.
 - 2. Air-Vent Piping: 240 deg F.
 - 3. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.
 - 4. All hydronic piping, components, devices, and coils shall be capable of withstanding a maximum of 240 deg F fluid temperature.

1.3 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping and Fittings.
 - 2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 3. Air control devices.
 - 4. Hydronic specialties.
- B. Operation and maintenance data.

1.4 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 1.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. Wrought-Copper Fittings: ASME B16.22.
 - 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:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company of America.
 - 2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
 - 3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Copper Pressure-Seal-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Viega; Plumbing and Heating Systems.
 - b. Nibco.
 - 2. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
- F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- G. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Central Sprinkler Company; a division of Tyco Fire & Building Products.
 - c. National Fittings, Inc.
 - d. S. P. Fittings; a division of Star Pipe Products.
 - e. Victaulic Company of America.
 - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - a. Note: Victaulic Flange Adaptor Kits Model #741 and # 743 are not permitted for use on this project.
 - 3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - a. Couplings shall accommodate pipe thermal expansion and contraction and shall be a Victaulic Style 177 flexible coupling or approved equal.

2.3 JOINING MATERIALS

- A. 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.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BA9-1, silver alloy for joining copper with bronze or steel.
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions:
 - 1. Standard: ASSE 1079.
 - 2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 3. End Connections: Solder-joint copper alloy and threaded ferrous.
- D. Dielectric Couplings:
 - 1. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

2.5 VALVES

- A. Globe, Check, Ball, and Gate Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."
- C. Automatic Flow-Control Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flow Design Inc.
 - b. Griswold Controls.
 - c. Nexus.
 - d. Pro Hydronic Specialties.
 - 2. Body: Brass or ferrous metal.
 - 3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.

4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 250 deg F.

2.6 AIR CONTROL DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amtrol.
 2. Bell & Gossett Domestic Pump; a division of ITT Industries.
 3. Taco.
 4. The John Wood Company.
- B. Manual Air Vents:
 1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Screwdriver or thumbscrew.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/8.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 225 deg F.

2.7 HYDRONIC PIPING SPECIALTIES

- A. Y-Pattern Strainers:
 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.
2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

C. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves where shown on the Drawings. .
- B. Install autoflow balancing valves of the type shown on the Drawings.
- C. 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 1, for installation requirements.
- D. Install isolation valves immediately upstream of any dielectric union.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. 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.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.

- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- S. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.

3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
7. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
8. NPS 3-1/2: Maximum span, 13 feet; minimum rod size, 1/2 inch.
9. NPS 4: Maximum span, 14 feet; minimum rod size, 5/8 inch.
10. NPS 6: Maximum span, 14 feet; minimum rod size, 5/8 inch.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 3/8 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 1/2 inch.
7. NPS 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.
8. NPS 4: Maximum span, 10 feet; minimum rod size, 1/2 inch.
9. NPS 6: Maximum span, 10 feet; minimum rod size, 1/2 inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 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. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. 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.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- I. Install dielectric fitting in piping at connections of dissimilar metal piping and tubing. Install an isolation valve immediately upstream of any dielectric union.
- J. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

3.7 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.

3.8 CHEMICAL TREATMENT

- A. Refer to section 232500 Water Treatment for requirements.

3.9 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.
 4. Isolate new and existing equipment and existing piping from the new 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 air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 3. Set temperature controls so all coils are calling for full flow.

END OF SECTION 232113

SECTION 232500 – HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following HVAC water-treatment systems:
 - 1. Chemical treatment
 - 2. Chemical treatment test equipment.
 - 3. HVAC water-treatment chemicals.

1.2 PERFORMANCE REQUIREMENTS

- A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.
- B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- C. The heating hot water system currently does not contain propylene glycol. All feed water serving the heating hot water system shall match the same water treatment that is currently in use in the heating hot water system. Coordinate with SCSD#2.
- D. Closed hydronic systems, including hot-water heating make up water shall have the following water qualities:
 - 1. pH: Maintain a value within 6.0 to 8.5.
 - 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 - 3. Total suspended solids below 10 ppm.
 - 4. Corrosion inhibitors shall be hard water compatible.
 - 5. Include a biocide to limit the growth of bacteria.
 - 6. Corrosion inhibiting compounds to protect metals at or below:
 - a. Aluminum < 0.25 MPY
 - b. Copper < 0.1 MPY, soluble copper < 0.25 ppm
 - c. Steel < 3.0 MPY According to ASTM D 2688
 - 7. Strong Acids shall not be used.
 - 8. Maintain Chlorides < 125 mg/l.
 - 9. Chemical additives must be approved for use in aluminum boilers.
 - 10. Use the same water treatment that is currently used in the heating hot water system. Coordinate with SCSD#2.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated below.

- B. Field quality-control test reports.
- C. Operation and maintenance data.
- D. Other Informational Submittals:
 - 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
 - 2. Water Analysis: Illustrate source water quality available at Project site.
 - 3. Water Analysis: Illustrate existing heating hot water solution conditions.

1.4 QUALITY ASSURANCE

- A. Water treatment contractor shall be Snow Crest Chemicals. Contact Snow Crest Chemicals at 406-256-7553.
- 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.

PART 2 - PRODUCTS

2.1 CHEMICAL TREATMENT EQUIPMENT

- A. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment. Match the same water treatment that is currently in use in the heating hot water system. Coordinate with SCSD#2.
- B. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.
- C. The heating hot water system currently does not contain propylene glycol. All feed water serving the heating hot water system shall match the same water treatment that is currently in use in the heating hot water system. Coordinate with SCSD#2.
- D. Additives used in the heating hot water system must be approved for use in aluminum boilers.

2.2 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.
- B. The existing school's chemical is Freemont #9910.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.
- B. Perform an analysis of the existing heating hot water solution prior to conducting any demolition work.

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 equipment to allow service and maintenance.

3.3 CHEMICAL TREATMENT

- A. All new heating hot water piping shall be cleaned. Contractor shall provide a temporary pump and loop as required to clean the new heating hot water piping.
- B. Fill all new piping with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Under no circumstance shall petroleum-based cleaning compounds be used in the boiler system or circulate through the existing system. Circulate solution for a minimum of 24 hours, drain, flush system, clean strainer screens, and refill with fresh water.
 - 1. Contractor shall add chemical treatment to the entire system to achieve the required water treatment quality.
 - 2. Presently the District's chemical is Freemont #9910. Contractor shall use Freemont #9910 for the project to charge the system after any draining processes or phases. Any remaining Freemont #9910 at the completion of the project shall be given to the School District for their inventory.

3.4 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. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.

2. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 3. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 4. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 5. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
 6. Repair leaks and defects with new materials and retest piping until no leaks exist.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. At eight-week interval following Substantial Completion, perform separate water analyses on hydronic systems to show that chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.
- F. Comply with ASTM D 3370 and with the following standards:
1. Silica: ASTM D 859.
 2. Acidity and Alkalinity: ASTM D 1067.
 3. Iron: ASTM D 1068.
 4. Water Hardness: ASTM D 1126.

END OF SECTION 232500

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND AND OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise 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. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
 - f. Other qualified fabricator subject to compliance with requirements.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for

static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: 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.
 2. Finishes for Surfaces Exposed to View: G60.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. 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.

2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
 1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.

5. Use: O.
 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations.

Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and oval ducts in maximum practical lengths.
 - 1. Install spiral round duct upstream of all VAV boxes or terminal units.
 - 2. Install longitudinal seam round duct or spiral round duct downstream of all VAV boxes or terminal units.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- 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, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor-Air, Supply-Air Ducts: Seal Class A.
3. Outdoor-Air, Exhaust Ducts: Seal Class C.
4. Outdoor-Air, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Hanger Exposed to View in Finished Spaces: Use steel cable support.
- F. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- G. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with 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.

3.5 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.6 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
- B. Supply Ducts:
 - 1. Ducts Connected to Terminal Units (downstream connection):
 - a. Pressure Class: Positive 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - 2. Ducts Connected to Variable-Air-Volume Terminal Units (upstream connection):
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
- C. Return Ducts:
 - 1. Ducts Connected to Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.

- b. Minimum SMACNA Seal Class: B.
- D. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
- E. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- F. Liner: (where noted on the mechanical Drawings)
 - 1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
 - 2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
 - 3. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.
- G. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Retain first three subparagraphs below, or delete and retain fourth subparagraph.
 - 2) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 3) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 4) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 5) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.
4. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: 45-degree entry.
5. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1500 fpm or lower: Conical tap.
 - b. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Flange connectors.
3. Turning vanes.
4. Duct-mounted access doors.
5. Flexible connectors.
6. Flexible ducts.
7. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
 - e. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and maintenance data.

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.

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.
 - 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 No. 4 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 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Cesco Products; a division of Mestek, Inc.
 - d. Greenheck Fan Corporation
 - e. Nailor Industries Inc.
 - f. Pottorff; a division of PCI Industries, Inc.
 - g. Ruskin Company.
 - 2. Frame: 20-gauge galvanized steel. (Aluminum for dampers installed in aluminum ductwork).
 - 3. Blades: 20-gauge galvanized steel. (Aluminum for dampers installed in aluminum ductwork).
 - 4. Control Shaft / Hand Quadrant: 3/8" square axle shaft extending beyond frame through factory mounted, locking hand quadrant.

5. Bearing: Molded synthetic.
6. Finish: Mill galvanized. (Aluminum for dampers installed in aluminum ductwork).
7. Insulation Bracket: 2" hand quadrant stand-off bracket.

2.3 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.4 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. METALAIRE, Inc.
 4. SEMCO Incorporated.
 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 36" Insert dimension wide and double wall for larger dimensions.

2.5 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
 2. Flexmaster U.S.A., Inc.
 3. Greenheck Fan Corporation.
 4. McGill AirFlow LLC.
 5. Nailor Industries Inc.
 6. Pottorff; a division of PCI Industries, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
1. Door and Frame Material: Galvanized sheet steel.
 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 4. Factory set at 8-inch wg.
 5. Doors close when pressures are within set-point range.
 6. Hinge: Continuous piano.
 7. Latches: Cam.
 8. Seal: Neoprene or foam rubber.
 9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.6 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.

2. Duro Dyne Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the 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.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.7 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 4. JP Lamborn.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.

4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

C. Flexible Duct Connectors:

1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

2.8 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 shown on the drawings. 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. 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 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. At outdoor-air intakes and mixed-air plenums.
 3. Downstream from control dampers, backdraft dampers, and equipment.

4. 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.
5. Control devices requiring inspection.
6. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

M. Connect flexible ducts to metal ducts with draw bands.

N. Install duct test holes where required for testing and balancing purposes.

O. 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 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 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.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:

1. Roof-mounted Exhaust fan.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
- B. Operation and maintenance data.

1.3 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. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 ROOF-MOUNTED EXHAUST FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Engineering & Mfg. Corp.
 2. Twin City Fan Company.
 3. Loren Cook Company.
 4. Carnes Company HVAC.
 5. FlowAire.
- B. Description: Direct-driven, as scheduled on the drawings, centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

- C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Coatings: As listed on the Mechanical Drawing Schedule.
- F. Performance & Accessories:
 - 1. As listed on the Mechanical Drawing Schedules.
 - 2. Roof curb: provide curb adaptor – refer to the mechanical drawings.

2.2 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Install units with clearances for service and maintenance.
- C. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- D. 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."
- E. Install ducts adjacent to power ventilators to allow service and maintenance.
- F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections, as applicable to the specific fan type, 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. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 10. Shut unit down and reconnect automatic temperature-control operators.
 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233423

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:

1. Single-duct air terminal units.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.
- B. Operation and maintenance data.

1.3 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. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

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 SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers:
1. Carnes.
 2. Krueger.
 3. METALAIRE, Inc.; Metal Industries Inc.

4. Nailor Industries.
 5. Price Industries, Inc.
 6. Titus, Inc.
 7. Trane.
- B. Configuration: Volume-damper assembly inside unit casing with control components located inside a protective metal shroud.
- C. Casing: 0.034-inch steel.
1. Casing Lining: 1-inch dual density fiberglass at density of 1.5 lbs/ft³ with 4.0 lbs/ft³ face complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access:
 - a. Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.
 - b. Removable panel for upstream access to the reheat coil.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Air Flow Sensor: Multi-point averaging sensor supplied with balancing tees.
- E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
 2. Damper Position: Normally open.
- F. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed. Coils shall be capable of withstanding a maximum of 240 deg F fluid temperature.
- G. Direct Digital Controls: Furnished and field mounted by the Temperature Control Contractor.
- H. Accessories:
1. Bottom access door.
 2. Control enclosure for field mounted controls.
 3. Hanger brackets.
- I. Refer to the drawings for additional notes and accessories.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Install piping adjacent to air terminal units to allow service and maintenance.
- E. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- F. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."
- G. Ground units with electric heating coils 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."

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 2. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
 3. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.

- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows.
- B. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Diffusers, registers, and grilles.
- B. Related Sections:
 - 1. Division 23 Section "Air Duct Accessories" for volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS AND DIFFUSERS

- A. Grilles, Registers and Diffusers
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carnes.
 - b. METALAIRE, Inc.
 - c. Nailor Industries.
 - d. Krueger
 - e. Price Industries, Inc.
 - f. Titus, Inc.
 - 2. Material: As scheduled.
 - 3. Finish: Baked enamel, color selected by Architect, or as scheduled.
 - 4. Mounting: Duct connection.
 - 5. Dampers: Where scheduled.
 - 6. Material: Steel or Aluminum. (as scheduled)
- B. Source Quality Control

1. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. 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 practical. 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 or smoke dampers.
- D. Suspend ceiling diffusers from straight-line (opposite corners) to limit weight on associated duct in ceiling.
- E. Paint interior of ductwork serving all GRD's black where galvanized ductwork is visible.
- F. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

3.2 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 260030 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Preconstruction meeting.
- B. Coordination drawings.
- C. Submittals for review, information, and project closeout.
- D. Submittal procedures.

1.2 RELATED SECTIONS

- A. Division 01 - General Requirements
- B. Section 260032 - Product Requirements.
- C. Section 260035 - Execution Requirements: Additional coordination requirements.

1.3 PROJECT COORDINATION

- A. Project Coordinator: Construction Manager/General Contractor.
- B. Refer to Division 01 - All Sections.
- C. Cooperate with the Construction Manager/General Contractor in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.
- D. Comply with specified procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Construction Manager/General Contractor for use of temporary utilities and construction facilities.
- F. Coordinate field engineering and layout work under instructions of the Construction Manager/General Contractor.
- G. Make the following types of submittals to Engineer through the Construction Manager/General Contractor.
 - 1. Requests for interpretation/information.
 - 2. Requests for substitution.

3. Shop drawings, product data, and samples (See also Section 260032).
4. Test and inspection reports.
5. Manufacturer's instructions and field reports.
6. Applications for payment and change order requests.
7. Progress schedules.
8. Coordination drawings.
9. Closeout submittals.
10. As-built Record Drawings.
11. Operation and Maintenance Manuals.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MEETING

- A. Engineer will schedule a meeting after Notice of Award.
- B. Contractor shall attend if requested by Construction Manager/General Contractor or required by Division 01.
- C. Refer to Division 01 for additional requirements.

3.2 Refer to Division 01 - Administrative Requirements, for additional requirements on the following:

- A. Pre-Construction Meeting.
- B. Progress Meetings.
- C. Construction Progress Schedule.
- D. Submittals for Review (See also Section 260032).
- E. Submittals for Information.
- F. Submittals for Project Closeout.
- G. Number of Copies of Submittals.
- H. Submittal Procedures.

3.3 THE REQUIREMENTS OF DIVISION 01 SHALL APPLY TO ALL SECTIONS OF DIVISION 26, 27, and 28.

3.4 COORDINATION DRAWINGS

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Engineer.

3.5 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.
- B. Submit to Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below.

3.6 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Certificates.
 - 2. Test reports.
 - 3. Inspection reports.
 - 4. Manufacturer's instructions.
 - 5. Manufacturer's field reports.
 - 6. Other types indicated.

3.7 SUBMITTALS FOR PROJECT CLOSEOUT

- A. When the following are specified in individual sections, submit them at project closeout:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Test reports.
 - 6. Certifications.
 - 7. Other items as indicated.

3.8 NUMBER OF COPIES OF SUBMITTALS

- A. Quantity of submitted items shall be as outlined in Division 01.

3.9 SUBMITTAL PROCEDURES

- A. Contractor shall submit in accordance with Division 01 requirements.
- B. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- C. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents. Submittals without a Contractor's stamp will be rejected and returned without review by the Engineer.
- D. Deliver submittals through the proper channels as outlined in Division 01.
- E. The contractor shall prepare a Submittal Schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule for the Engineer's approval. The Submittal Schedule (and all updates) shall be distributed to the Engineer. The Submittal Schedule shall be expressed in terms of milestones, not specific dates. Submittals shall be scheduled to expedite the Project, and coordinate submission of related items. If a Submittal Schedule is NOT furnished to the Engineer, allow 15 business days excluding delivery time to and from the Contractor.
- F. The Contractor shall provide, in writing, an itemized list of all variations from the Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work. The Contractor shall also flag or denote all such variations within the body of the shop drawings.
- G. Provide space for Contractor and Engineer review stamps.
- H. When revised for resubmission, identify all changes made since previous submission.
- I. Contractor shall also prepare all submittal documents in digital format for posting on a document exchange site such as Submittal Exchange. This shall be provided at no additional cost to the contract. Contractor shall fully resolve any technical difficulties encountered by the Engineer with the document exchange site within 3 business days upon written notification by the Engineer. If document exchange site technical difficulties cannot be resolved within 3 business days to the satisfaction of the Engineer, and alternative method of electronic distribution shall be established (i.e. email).
- J. All shop drawing submittals shall have a complete bill of material itemized listing of all parts included at the front of the submittal.
- K. Submittals not required by the Contract will be returned without review by the Engineer. The Engineer offers no comment on non-required submittals.

END OF SECTION 260030

SECTION 260032 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations and procedures.
- E. Spare parts and maintenance materials.

1.2 RELATED SECTIONS

- A. General Requirements: Division 01 - All Divisions.
- B. Electrical: Division 26 - All Sections.

1.3 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project.
- C. Submit shop drawings and product data as required by various sections of Divisions 26, in accordance with Division 01. Make submittals to Engineer via the General Contractor. Do not submit directly to the Engineer.
- D. Indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. All products provided by the Contractor for this project shall be new, and shall be UL Listed where applicable.

- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- C. Provide interchangeable components of the same manufacture for components being replaced.
- D. Motors: Refer to Sections 220513 and 230513, NEMA MG 1 Type. Specific motor type is specified in individual specification sections.
- E. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.
- F. Cord and Plug: Provide minimum 6 foot (2 m) cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

2.2 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.3 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Provide spare parts, maintenance, and extra products of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 - EXECUTION

3.1 SUBSTITUTION PROCEDURES

- A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Bidders shall submit all Substitution Submittal Requests no later than 10 business days prior to the Bid Date (date deadline). Submittal Request received after 4:00PM MT are considered to be received the following business day. Substitution Submittal Requests after the date deadline will not be reviewed. Comply with requirements specified in this section and Division 01.
- B. All product substitutions shall be by Addendum, or with written approval only.
- C. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

- D. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- E. A request for substitution constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner and Engineer for review or redesign services associated with re-approval by authorities.
- F. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- G. Substitution Submittal Procedure:
 - 1. Submit two copies of request for substitution for consideration. Limit each request to one proposed substitution.
 - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
 - 3. Engineer will notify Contractor in writing of decision to accept or reject request.

3.2 OWNER-SUPPLIED PRODUCTS

- A. Owner 's Responsibilities (Unless Otherwise Noted Elsewhere):
 - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor 's Responsibilities (Unless Otherwise Noted Elsewhere):
 - 1. Review Owner reviewed shop drawings, product data, and samples.
 - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - 3. Handle, store, install and finish products.
 - 4. Provide electrical connections to equipment according to manufacturer's instructions, and Contract Documents.
 - 5. Repair or replace items damaged by this Contractor.

3.3 TRANSPORTATION AND HANDLING

- A. Transport and handle products in accordance with manufacturer's instructions. All transportation costs shall be by this Contractor.
- B. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

3.4 STORAGE AND PROTECTION

- A. Store and protect products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- D. For exterior storage of fabricated products, place on sloped supports above ground.
- E. Provide off-site storage and protection when site does not permit on-site storage or protection. Certificate of Insurance is required for off-site storage.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- H. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 260032

SECTION 260035 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Existing utilities.
- D. Laying out of work.
- E. Temporary lighting and power
- F. Cutting and patching.
- G. Progress cleaning.
- H. Protection of installed work.
- I. Starting systems.
- J. Demonstration and installation.
- K. Adjusting.
- L. Final cleaning.
- M. Closeout procedures, except payment procedures.
- N. Project record documents.
- O. Operation and maintenance data for equipment and systems.
- P. Operation and maintenance manuals.
- Q. Warranties and bonds.
- R. Maintenance service.

1.2 RELATED SECTIONS

- A. Division 01 - General Requirements - All Sections.
- B. Section 033000: Cast -In-Place Concrete.

- C. Electrical: Division 26 - All Sections.

1.3 SUBMITTALS

- A. Cutting and Patching: Submit written request in advance of cutting or alteration which affects:

1. Structural integrity of any element of Project.
2. Integrity of weather exposed or moisture resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight exposed elements.
5. Work of Owner or separate Contractor.
6. Include in request:
 - a. Identification of Project.
 - b. Location and description of affected work.
 - c. Necessity for cutting or alteration.
 - d. Description of proposed work and Products to be used.
 - e. Effect on work of Owner or separate Contractor.
 - f. Written permission of affected separate Contractor.
 - g. Date and time work will be executed.

1.4 PROJECT CONDITIONS

- A. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water.
- C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.
- E. Erosion and Sediment Control: Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
1. Minimize amount of bare soil exposed at one time.
 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

- G. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

1.5 COORDINATION

- A. Coordinate with Construction Manager/General Contractor and Owner to complete work in proper sequence.
- B. Coordinate work of alterations and renovations to expedite completion sequentially and to accommodate occupancy requirements.
- C. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- D. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.
- H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 - PRODUCTS

2.1 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

2.2 EQUIPMENT HOUSEKEEPING PADS

- A. Fixed concrete bases for electrical equipment will be provided under Division 03. The Electrical Contractor shall inform Division 03 Contractor before bid time of all required pads so that the

cost for these pads are included in the Division 03 bid. If this is not coordinated the Electrical Contractor is responsible for all costs associated with the installation of these pads.

- B. Coordinate with Division 03 Contractor to assure that all outside corners are beveled, anchor bolts are provided per equipment manufacturer's recommendations, and that pad horizontal dimensions are 3" larger than the footprint of the equipment on all sides.
- C. Provide reinforced concrete housekeeping pads for all floor mounted electrical equipment (i.e. distribution panels, step-down transformers, etc.)
- D. Provide anchor bolts, per equipment manufacturer's directions, to attach equipment to pads.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- D. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions. Protect work of other trades.

3.2 PREPARATION

- A. Remove debris and abandoned items from area and from concealed spaces.
- B. Close openings in exterior surfaces to protect existing work and salvage items from weather and extremes of temperature and humidity. Insulate ducts and piping to prevent condensation in exposed areas.
- C. Prepare surfaces and remove surface finishes to provide for proper installation of new work and finishes.
- D. Clean substrate surfaces prior to applying next material or substance.
- E. Seal cracks or openings of substrate prior to applying next material or substance.
- F. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install Products as specified in individual sections.
- B. Make neat transitions. Patch work to match adjacent work in texture and appearance.
- C. All ceiling mounted devices (i.e. smoke detectors, speakers, light fixtures, etc.) shall be installed centered in ceiling tiles (Unless otherwise noted). Coordinate with ceiling installer.

3.4 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a pre-installation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.

3.5 EXISTING UTILITIES

- A. The plans indicate as accurately as possible the location, type and sizes of existing underground utilities at the site. It is the Contractor's responsibility to have all utilities located prior to starting work. Contractor shall contact appropriate utility companies and One Call of Wyoming for locating utilities prior to commencement of any work.
- B. This contractor shall protect all utilities affected by his work, and shall repair any damage caused by his forces at no cost to Owner.
- C. Owners of all underground facilities shall be notified at least 3 business days prior to excavation.

3.6 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Engineer of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to the Engineer.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means.

1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
2. Grid or axis for structures.
3. Building foundation, column locations, ground floor elevations.

- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

3.7 TEMPORARY LIGHTING AND POWER

- A. Comply with Division 01.
- B. Provide all temporary facilities required to supply construction power and light. Install and maintain facilities in a manner that will protect the public and workmen. Comply with all applicable laws and regulations.
- C. Upon completion of work, remove all temporary facilities from the project site.
- D. The Electrical Contractor shall provide power and lighting for construction as outlined in the General Requirements and/or Special Conditions. Where required to be separately metered the Electrical Contractor shall supply all materials for metering. Electrical Contractor shall coordinate with the Construction Manager/General Contractor to ensure all costs for temporary power and all electrical usage is paid for as part of this contract. The Contractors are responsible for any charges related to temporary power and its usage.
- E. When the Electrical Utility is needed for specific power outages the Electrical Contractor will be responsible for paying any costs associated with utility shut downs and shall pay the Utility Company for any charges incurred.

3.8 CUTTING AND PATCHING

- A. Execute cutting and patching including excavation and fill to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.
- B. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing.
- C. Cut rigid materials using masonry saw or core drill. Pneumatic or electric impact-type tools not allowed without prior approval.
- D. Restore work with new Products in accordance with requirements of Contract Documents.
- E. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

- F. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 260050, to full thickness of the penetrated element.
- G. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections. Repair substrate prior to patching finish. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.9 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition per OSHA standards.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.

3.10 PROTECTION OF INSTALLED WORK

- A. Protect installed work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.
- C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- D. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- E. Prohibit traffic from landscaped areas.

3.11 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Engineer and owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Provide written test results to owner with all data.

3.12 DEMONSTRATION AND INSTRUCTION

- A. Contractor shall complete all start-up and perform all initial testing of each system prior to scheduling or requesting to schedule training. All systems shall be completely operational before training or demonstration will occur.
- B. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.
- C. Demonstrate operation and maintenance of Products to Owner's representative at a scheduled time with the Owner.
- D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.
- F. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

3.13 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

3.14 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
 - 1. Clean areas to be occupied by Owner prior to final completion and before Owner occupancy.
- B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

- C. Remove waste and surplus materials, rubbish, and construction facilities from the site.

3.15 CLOSEOUT PROCEDURES

- A. Refer to Division 01 Requirements.
- B. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Engineer and Owner.
- C. Notify Engineer when work is considered ready for Substantial Completion.
- D. Correct items of work listed in executed Certificates of Substantial Completion and comply with requirements for access to Owner occupied areas.
- E. Notify Engineer when work is considered finally complete.
- F. Complete items of work determined by Engineer's final inspection.

3.16 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Record information concurrent with construction progress.
- D. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Changes made by Addenda and modifications.
- E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 2. Field changes of dimension and detail.
 - 3. Details not on original Contract drawings.

- F. At completion of project Contractor shall provide a minimum of two sets of As-Built Record drawings. Additional sets shall be provided if required under General Requirements.

3.17 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- C. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions.
- D. Include manufacturer's printed operation and maintenance instructions for each component.
- E. Include sequence of operation by controls manufacturer.
- F. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- G. Provide control diagrams by controls manufacturer as installed (as-builts).
- H. Additional Requirements: As specified in individual product specification sections.

3.18 OPERATION AND MAINTENANCE MANUALS

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- B. Prepare data in the form of an instructional manual.
- C. Binders: Commercial quality, 8-1/2 x 11 inch (216 x 280 mm) three D side ring binders with durable plastic covers; 3 inch (75 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify Contractor Name; identify Engineer Firm name; identify subject matter of contents.
- E. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.

- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
- I. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Photocopies of warranties and bonds.
- J. O&M manual submittals for luminaires shall be complete in all aspects and at a minimum shall contain, but are not limited to, the following: (1) Light fixture cutsheet, (2) Ballast or LED driver board cutsheet, (3) Integral emergency LED driver board/battery pack or ballast/battery pack cutsheet (as applicable to the project) and (4) Lamps or LED device board cutsheet. O&M manual submittals for luminaires shall have a complete luminaire schedule on company letterhead included at the front of the submittal which shall at a minimum include the following technical data: manufacturer, model number, lumens (LM), watts (W) and lumens/watt (LPW).
- K. At completion of project Contractor shall provide a minimum of two paper sets of Operational and Maintenance manuals that contain all the items listed under OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS and WARRANTIES AND BOND. Additional sets shall be provided if required under General Requirements. Also, furnish two electronic sets of manual (1 on USB flash drive, 1 on CD-ROM).

3.19 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work. Except for items put into use with Owner 's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.
- F. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- G. All warranty related work shall include all travel expenses, lodging and food. The cost of all services to perform the Warranty work shall be included at no additional cost. All materials, labor and equipment necessary to perform warranty work and return warranted item to operational status shall also be included at no additional cost unless specifically identified in the individual specification sections.

3.20 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in specification sections for a minimum of 1 year from date of Substantial Completion.
- B. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- D. Maintenance service shall not be assigned or transferred to any agent or Subcontractor without prior written consent of the Owner.

END OF SECTION 260035

SECTION 260050 - FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Firestopping materials.
- B. Firestopping of all penetrations and interruptions to fire rated assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 RELATED SECTIONS

- A. Section 260035 - Execution Requirements: Cutting and patching.
- B. Section 260519 - Low-Voltage Power Conductors and Cables.
- C. Section 260534 - Conduit.

1.3 REFERENCES

- A. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 1995a.
- B. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 1994b.
- C. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- D. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- E. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.4 SUBMITTALS

- A. No submittals are required for this section.

1.5 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with ASTM E 814 and ASTM E 119.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant; conforming to the following:
 - 1. Durability and Longevity: Permanent.
 - 2. Color: Per Manufacturer.
 - 3. Manufacturers:
 - a. 3M Product CP25WB+.
- B. Foam Firestopping: Single component foam compound; conforming to the following:
 - 1. Durability and Longevity: Permanent.
 - 2. Color: Per Manufacturer.
- C. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers; conforming to the following:
 - 1. Durability and Longevity: Permanent.
 - 2. Color: Per Manufacturer.
- D. Fiber Packing Material: Mineral fiber packing insulation; conforming to the following:
 - 1. Durability and Longevity: Permanent.
- E. Firestop Devices: Mechanical device with incombustible filler and sheet stainless steel jacket; conforming to the following:
 - 1. Durability and Longevity: Permanent.
 - 2. Manufacturers:
 - a. EZ Pathway Products; Product EZ Path.
- F. Intumescent Putty: Compound which expands on exposure to surface heat gain; conforming to the following:
 - 1. Potential Expansion: Minimum 1000 percent.
 - 2. Durability and Longevity: Permanent.
 - 3. Color: Per Manufacturer.
 - 4. Manufacturers:

- a. 3M Product MPS+.
 - b. 3M Product MPP+.
- G. Firestop Pillows: Formed mineral fiber pillows; conforming to the following:
 - 1. Durability and Longevity: Permanent.
 - 2. Manufacturers:
 - a. 3M Product FB249.
 - b. 3M Product FB269.
 - c. 3M Product FB369.
- H. Primers, Sleeves, Forms, and Accessories: Type required for tested assembly design.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.
- B. Remove incompatible materials which may affect bond.

3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authority having jurisdiction.

3.4 CLEANING AND PROTECTION

- A. Clean adjacent surfaces of firestopping materials.

END OF SECTION 260050

SECTION 260519 - LOW-VOLTAGE POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wire and cable for 600 volts and less.
- B. Wiring connectors.
- C. Electrical tape.
- D. Wire pulling lubricant.
- E. Cable ties.

1.2 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 283100 - Fire Detection and Alarm: Fire alarm system conductors and cables.
- C. Section 260534 - Conduit.

1.3 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- G. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy; 2009.

- H. NEMA WC5 - Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- K. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- M. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- N. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. There are no shop drawing submittals required for this section.
- B. Project Record Documents: Record actual locations of components and circuits.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.7 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer and obtain direction before proceeding with work.

PART 2 - PRODUCTS

2.1 WIRING REQUIREMENTS

- A. Dry Interior Locations: Use only building wire with Type THWN/THHN insulation in raceway.
- B. Wet or Damp Interior Locations: Use only building wire with Type THWN insulation in raceway.
- C. Exterior Locations: Use only building wire with Type THHN/THWN insulation in raceway, unless specifically noted otherwise.
- D. Underground Installations: Use only building wire with Type THHN/THWN insulation in raceway.
- E. Use solid conductor for feeders and branch circuits No.10 AWG and smaller, and stranded conductor for feeders and branch circuits No. 8 AWG and larger.
- F. Use stranded conductors for control circuits.
- G. Use conductor not smaller than 12 AWG for power and lighting circuits.
- H. Use conductor not smaller than 14 AWG for control circuits.
- I. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m).
- J. Aluminum cable is not allowed.
- K. This contractor shall derate conductor ampacity in areas of high ambient temperature per the NEC.
- L. All branch circuits served by a single pole breaker shall be provided with a separate, dedicated neutral conductor throughout. Shared neutrals on these circuits will not be allowed.
- M. No more than three (3) branch circuits will be allowed in conduit homeruns.
- N. All branch circuits serving non-linear loads (i.e. personal computer, mainframe computers, computer terminals, fax machines, electronic ballasts, receptacles adjacent to data outlets, etc.) shall have a minimum neutral conductor size of #10 Cu. This includes all receptacles in offices, open office areas, reception areas, copy rooms, communications/server closets, etc.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
- H. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - 3. Color Code:
 - a. 480Y/277V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Purple.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.
 - b. 208Y/120V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - c. Equipment Ground, All Systems: Green.
 - d. Travelers for 3-Way and 4-Way Switching: Purple.
 - e. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers: Anaconda, Cyprus Wire and Cable Company (Rome), General Electric Company, General Cable Company, Pirelli or approved equivalent.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600V.
- E. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

2.4 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Solderless Pressure Connectors:
 - 1. Product: 3M Scotchlok Brand, Type Y, R, G, and B, or Ideal Model 451, 452, 453, and 455 or equal.
- C. Splices and taps for conductor sizes No. 8 and larger, use approved gutter taps similar to O.Z. type PMX combination parallel gutter taps and covers.
- D. Where tapping of conductors is required, use minimum of two layers wrapped half lapped. Tape shall be a minimum of 150% of thickness of insulation. Tape shall be U.L. Listed 3M Scotch Brand 33+.

2.5 WIRING ACCESSORIES

- A. Electrical Tape:
 - 1. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
- B. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
- C. Cable Ties: Material and tensile strength rating suitable for application.
- D. Solderless Pressure Connectors:
 - 1. Product: 3M Scotchlok Brand, Type Y, R, G, and B, or Ideal Model 451, 452, 453, and 455 or equal.
- E. Splices and taps for conductor sizes No. 8 and larger, use approved gutter taps similar to O.Z. type PMX combination parallel gutter taps and covers.
- F. Where tapping of conductors is required, use minimum of two layers wrapped half lapped. Tape shall be a minimum of 150% of thickness of insulation. Tape shall be UL Listed 3M Scotch Brand 33+.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.

- C. Verify that raceways, boxes, electrical connections (which includes but is not limited to all existing and new lugs on the project), and equipment enclosures are installed and are properly sized to accommodate existing or new conduit/conductors or cables in accordance with NFPA 70. The sizes and total quantity of all lugs and their compatibility with proposed conduit/conductors or cables shown on the Contract Documents shall be field verified PRIOR to the installation of any new conduit/conductors or cables on the project. It is the sole responsibility of the electrical contractor that all existing and new lugs are properly sized to accommodate existing or new conduit/conductors or cables in accordance with NFPA 70.
- D. Verify that raceway installation is complete and supported.
- E. Protect conductors from paint.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- C. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.
 - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- D. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- E. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
- F. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- G. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.

- 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.
 - H. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - I. Insulate ends of spare conductors using vinyl insulating electrical tape.
 - J. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
 - K. All wire and cable shall be installed within conduit or other raceway system.
 - L. Conduits shall have a maximum fill in accordance with NEC requirements and wire and cable shall be installed within conduits as outlined in Section 260534 Conduit.
 - M. Route wire and cable as required to meet NEC and project conditions.
 - 1. Wire and cable routing indicated is approximate unless dimensioned.
 - 2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
 - 3. Include wire and cable of lengths required to install connected devices within 10 ft (3000 mm) of location shown.
 - N. Use wiring methods indicated.
 - O. Clean conductor surfaces before installing lugs and connectors.
 - P. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - Q. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
 - R. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
 - S. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
 - T. Identify and color code wire and cable under provisions of Section 260553. Identify each conductor with its circuit number or other designation indicated.
- 3.4 FIELD QUALITY CONTROL
- A. Perform inspection, testing, and adjusting in accordance with Section 014000.

- B. Correct deficiencies and replace damaged or defective conductors and cables. Retain and revise applicable piping applications in this article. Coordinate with materials specified.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding components, including grounding electrodes and conductors, equipment grounding conductors, and bonding to complete grounding system consisting of:
- B. Metal underground water pipe electrode.
- C. Metal frame of the building.
- D. Rod electrodes.
- E. Concrete-encased electrode.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 260519 - Low-Voltage Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms maximum.

1.5 SUBMITTALS

- A. See Division 01 for submittals procedures.
- B. Test Reports: Indicate overall resistance to ground.
- C. Project Record Documents: Record actual locations of components and grounding electrodes.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
 - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in addition to requirements of Section 260519:
 - 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).

- C. Connectors for Grounding and Bonding:
 - 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 - 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 - 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

2.3 ELECTRODES

- A. Provide new grounding electrodes at new service as detailed on the drawings and/or as required by NEC.
- B. Rod Electrodes: Copper.
 - 1. Diameter: 3/4 inch (19 mm).
 - 2. Length: 10 feet (3000 mm).
 - 3. Shape: Straight.
- C. Metallic water pipe electrodes: 3/0 AWG.
- D. Foundation Electrodes: 3/0 AWG.

2.4 CONNECTORS AND ACCESSORIES

- A. Mechanical Connectors (for indoor locations only): Bronze.
 - 1. Product: by O.Z. Gedney or equal.
- B. Exothermic Connections:
 - 1. Product: by Cadweld or equal.
- C. Wire: Stranded copper.
- D. Grounding Electrode Conductor: Size to meet NFPA 70 requirements. Minimum #3/0 bare copper interconnecting ground conductors.
- E. Motor shaft grounding:
 - 1. Provide field installed shaft grounding for all motors served by VFD's.
 - 2. Provide Aegis SGR or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that conditions are satisfactory for installation prior to starting work.

- C. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.
- C. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- D. Identify grounding and bonding system components in accordance with Section 260553.
- E. Provide electrical service and distribution grounding system as indicated in drawings and outlined in this specification and as required by NEC.
- F. Install ground electrodes at locations as required. Install additional rod electrodes as required to achieve specified resistance to ground.
- G. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing.
- H. Provide bonding to meet requirements described in Quality Assurance.
- I. Bond together each metallic raceway (2" and larger), pipe, duct and other metal object entering equipment enclosures. Use bare copper conductor, sized per NEC or as shown on plans (whichever is the most stringent).
- J. Equipment Grounding Conductor: Provide separate, insulated copper equipment grounding conductor in all of the following runs listed below. Terminate each end on suitable lug, bus, or bushing. Where ground conductors are specified or required, conduit sizes shall be increased as necessary to meet the NEC conduit fill requirements.
 - 1. All new feeders.
 - 2. All raceways for receptacle circuits, including special power receptacles.
 - 3. All feeds to light fixtures.
 - 4. All motor feeders and branch circuits.
 - 5. All flexible metal conduit.
 - 6. All non-metallic raceways containing power conductors.

- K. Terminate each end of equipment ground conductors in an approved lug or bus or bushing.
- L. In general, equipment ground conductors are not indicated on the plans. Where ground conductors are required, conduit sizes shall be increased as required to comply with NEC conduit fill requirements.
- M. Where a pad mounted transformer is installed, the ground network shall consist of four (4) ground rods, one at each corner of the transformer pad, and interconnect with #1/0 bare copper conductor. Extend separate ground conductors to the primary and secondary side of the transformer. All ground connections below grade shall be of the exothermic weld type. Ground all conduits in the transformer enclosure using grounding bushings. Ground stress cones, lightning arrestors, transformer housings, and all non current carrying metal parts to the ground network. Provide a grounding jumper, provided by the manufacturer, between the grounding network and the transformer neutral.

3.3 FIELD QUALITY CONTROL

- A. Perform inspections listed in NETA STD ATS, Section 7.13.
- B. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- C. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION 260529

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1.1 SECTION INCLUDES

- A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.
- B. Anchors and fasteners.
- C. For communications cabling, see also specific sections.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 260534 - Conduit: Additional support and attachment requirements for conduits.
- C. Section 260537 - Boxes: Additional support and attachment requirements for boxes.
- D. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- E. Section 271021 - Voice/Data Systems - Cat 6.

1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. MFMA-4 - Metal Framing Standards Publication; 2004.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 - 2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 2. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equal unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equal unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 - 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 - 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Steel Spring Clips:
 - 1. Product: Caddy, or equal.
 - 2. Use only in concealed locations (i.e. above ceilings, within walls, etc).
- D. Supports: Fabricated of structural steel or formed steel members; galvanized or painted, as required.
- E. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- F. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 - 1. Comply with MFMA-4.
 - 2. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
- G. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

H. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Do not use powder-actuated anchors.
3. Concrete Structural Elements: Use preset concrete inserts, expansion anchors, or screw anchors.
4. Steel Structural Elements: Use beam clamps, steel ramset fasteners, or welded fasteners.
5. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
6. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
7. Solid Masonry Walls: Use expansion anchors or preset inserts.
8. Sheet Metal: Use sheet metal screws.
9. Wood Elements: Use wood screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, in accordance with NECA 1.
 1. Do not drill or cut structural members, unless specifically approved in writing by Structural Engineer.
- C. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- D. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- E. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
- F. All supports shall be securely positioned to the structure, not equipment or ceiling tile supports. Coordinate structure load capabilities with General Contractor.
- G. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- H. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- I. Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

- 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
- 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

- J. Interior Luminaire Support and Attachment: Also comply with Section 265100.
- K. Secure fasteners according to manufacturer's recommended torque settings.
- L. Remove temporary supports.

3.2 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.
- E. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.

END OF SECTION 260529

SECTION 260534 - CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Intermediate metal conduit (IMC).
- C. PVC-coated galvanized steel rigid metal conduit (RMC).
- D. Flexible metal conduit (FMC).
- E. Liquid tight flexible metal conduit (LFMC).
- F. Electrical metallic tubing (EMT).
- G. Rigid polyvinyl chloride (PVC) conduit.
- H. Conduit fittings.
- I. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260537 - Boxes.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.

- F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- H. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2005.
- I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
- J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- M. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- N. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- O. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- Q. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- R. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. There are no shop drawing submittals required for this section.
- B. Shop Drawings:
 - 1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
- C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (51 mm) trade size and larger.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

- A. Conduit Size: Comply with NFPA 70.
 - 1. Minimum Size: 3/4 inch (19 mm) for circuit homeruns, and for runs with more than the equivalent of three single circuits served with single pole breakers and #12 AWG conductors. 1/2" conduit may be used for all other runs with the equivalent of 7 #12 AWG conductors or less.
- B. Underground Installations:
 - 1. More than 5 Feet (1.5 Meters) from Foundation Wall: Use thickwall non-metallic conduit.
 - 2. Through foundation walls and five feet either side: Use plastic coated rigid steel conduit.
 - 3. Where conduits turn up from under slab or from underground: Use plastic coated rigid steel conduit until above slab or grade.
 - 4. Under Slab on Grade: Use thickwall non-metallic conduit.
 - 5. Minimum Size: 3/4 inch (19 mm).
 - 6. Other locations shall be Schedule 80 PVC.
- C. Outdoor Locations Exposed Above Grade: Use rigid steel conduit or intermediate metal conduit.
- D. In Slab Above Grade: Conduits shall not be routed in concrete floor topping.
 - 1. Use rigid steel conduit or intermediate metal conduit with appropriate protective coating.
- E. Wet and Damp Locations: Use rigid steel conduit or intermediate metal conduit.
 - 1. Liquid tight conduit with liquid tight fittings shall be used for final connection to equipment in kitchens, wells, sump pits, transformer connections, underfloor in computer/server rooms and other areas of moisture content.
- F. Dry Locations:
 - 1. Concealed: Use electrical metallic tubing.
 - 2. Exposed: Use electrical metallic tubing.
 - 3. Flexible metal conduit shall be used for connections to motors, fixed appliances, equipment subject to vibration, and recessed luminaires where required.
- G. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

- H. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
- I. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.2 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers: Republic Conduit, Youngstown, Triangle, Allied Tube & Conduit, Wheatland Tube Company, or approved equal.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.
 - 4. All connectors shall have insulated throats.

2.3 INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers: Republic Conduit, Youngstown, Triangle, Allied Tube & Conduit, Wheatland Tube Company, or approved equal.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.4 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers: Allied, Robroy Industries, or approved equal.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil (1.02 mm).

- D. PVC-Coated Fittings:
 - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 - 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
 - 3. Material: Use steel.
 - 4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil (1.02 mm).
 - 5. All connectors shall have insulated throats.
- E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil (0.38 mm).

2.5 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers: AFC Cable Systems, Inc, Electri-Flex Company, International Metal Hose, or approved equal.
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel.
 - 3. All connectors shall have insulated throats.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers: AFC Cable Systems, Inc, Electri-Flex Company, International Metal Hose, Anamet Electrical, Inc, or approved equal.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel.
 - 3. All connectors shall have insulated throats.

2.7 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers: Republic Conduit, Youngstown, Triangle, Allied Tube & Conduit, Wheatland Tube Company, or approved equal.
- B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel.
 - a. Do not use die cast zinc fittings.
3. Connectors and Couplings: Use set-screw type.
 - a. Do not use indenter type connectors and couplings.
4. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.
5. All connectors shall have insulated throats.

2.8 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers: Carlon, Triangle, Johns-Manville or approved equal.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 1. Manufacturer: Same as manufacturer of conduit to be connected.
 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.9 ACCESSORIES

- A. Any paints or coatings used on this project need to be in compliance with LEED requirements. VOC emissions from these materials must not exceed the VOC and chemical component limits of Green Seal's Standard GS-11 requirements.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force (890 N).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive conduits.

- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify routing and termination locations of conduit prior to rough-in.
- E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.2 INSTALLATION

- A. At contractor's option, existing conduit in remodeled areas may be reused for new branch circuits and feeders where practical, and as noted on the plans. Existing conduits shall meet all requirements for new conduit as specified herein, and shall be warranted as new by the contractor.
- B. Install products in accordance with manufacturer's instructions.
- C. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- D. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- E. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
- G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- H. Install nonmetallic conduit in accordance with manufacturer's instructions.
 - 1. For all nonmetallic conduit runs 2 inch trade size and larger, all sweeps shall be of galvanized rigid construction. If sweeps are underground, sweeps shall be coated with two coats of tar prior to installation or shall be PVC coated.
- I. Cut conduit square using saw or pipecutter; de-burr cut ends.
- J. Bring conduit to shoulder of fittings; fasten securely.
- K. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- L. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations.
- M. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate bends in metal conduit larger than 2 inch (50 mm) size. Runs that require more than three 90 degree bends shall be brought to the attention of the Engineer.
- N. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

- O. Provide suitable pull string in each empty conduit except sleeves and nipples.
- P. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- Q. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated and routing is not shown, determine exact routing required.
 - 3. Conceal all conduits unless specifically indicated to be exposed.
 - 4. Arrange conduit to maintain headroom and present neat appearance.
 - 5. Route exposed conduit parallel and perpendicular to walls.
 - 6. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
 - 7. Route conduit under slab, and underground from point-to-point.
 - 8. No conduit shall be run within concrete slabs unless specifically noted otherwise.
 - 9. Maintain adequate clearance between conduit and piping.
 - 10. Maintain 12 inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
 - 11. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
- R. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 3. Group related conduits; support using conduit rack. Construct rack using steel channel ; provide space on each for 25 percent additional conduits.
 - 4. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
 - 5. Arrange supports to prevent misalignment during wiring installation.
- S. Connections and Terminations:
 - 1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 - 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 - 3. Use suitable adapters where required to transition from one type of conduit to another.
 - 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 - 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 - 6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
 - 7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- T. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.
 5. Provide conduit seals where raceway enters the building from underground. Seal in accordance with NEC requirements.
 6. Where conduits pass through exterior walls or roofs, Contractor shall seal penetrations with materials outlined in Section 079200.
 7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
 9. Where conduits pass through smoke or fire rated walls Contractor shall seal penetrations with appropriate smoke and/or fire rated materials as outlined in Section 078400 and/or 260050.
- U. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 033000 with minimum concrete cover of 3 inches (76 mm) on all sides unless otherwise indicated.
- V. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where conduits are subject to earth movement by settlement or frost.
- W. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- X. Provide grounding and bonding in accordance with Section 260526.
- Y. Provide conduit seals where raceway enters the building from underground. Seal in accordance with NEC requirements.
- Z. Identify conduits in accordance with Section 260553.

3.3 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 260050.
- B. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation.

END OF SECTION 260534

SECTION 260537 - BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).
- C. Wall and ceiling outlet boxes.
- D. Pull and junction boxes.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 260032 – Product Requirements.
- C. Section 260035 – Execution Requirements.
- D. Section 260050 - Firestopping.
- E. Section 260526 - Grounding and Bonding for Electrical Systems.
- F. Section 260529 - Hangers and Supports for Electrical Systems.
- G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 260534 - Conduit: Conduit bodies and other fittings.
- I. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- J. Section 262726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Additional requirements for locating boxes for wiring devices.
- K. Section 271021 – Voice/Data Systems – Cat 6.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. SCTE 77 - Specification for Underground Enclosure Integrity; 2013.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- L. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 - 6. Coordinate the work with other trades to preserve insulation integrity.
 - 7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
 - 8. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Division 01 and Section 260030 for submittal procedures.
- B. Provide product data on floor boxes and handholes.
- C. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents. Also record actual locations of floor boxes on project record documents.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- C. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 BOXES

- A. General Requirements:
 - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 - 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 - 3. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
 - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 - 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
 - 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 - 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 - 3. Use suitable concrete type boxes where flush-mounted in concrete.
 - 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
 - 5. Use raised covers suitable for the type of wall construction and device configuration where required.
 - 6. Use shallow boxes where required by the type of wall construction.
 - 7. Do not use "through-wall" boxes designed for access from both sides of wall.

8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 9. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.
 10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 11. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 12. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
 13. Wall Plates: Comply with Section 262726.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

2.2 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 262716.
1. Material: Galvanized cast iron.
 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
 3. Material: Galvanized cast iron.
 4. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
 5. Cover Legend: Shall represent the system served.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify locations of floor boxes and outlets prior to rough-in.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
- E. Install boxes plumb and level.
- F. Flush-Mounted Boxes:
 - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
 - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 - 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.
- G. Install boxes as required to preserve insulation integrity.
- H. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- I. Close unused box openings.
- J. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- K. Provide grounding and bonding in accordance with Section 260526.
- L. Identify boxes in accordance with Section 260553.
- M. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
- N. Install in locations as shown on Drawings and approved by owner, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.
- O. Coordinate installation of outlet boxes for equipment connected under Section 262717.

- P. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- Q. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
 - 1. Adjust box locations up to 10 feet (3 m) if required to accommodate intended purpose, without adjustment in contract amount.
- R. Orient boxes to accommodate wiring devices oriented as specified in Section 262726.
- S. Maintain headroom and present neat mechanical appearance.
- T. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- U. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 12 inches (305 mm) from ceiling access panel or from removable recessed luminaire.
- V. Install boxes to preserve fire resistance rating of partitions and other elements.
- W. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- X. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- Y. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- Z. Use flush mounting outlet boxes in finished areas.
- AA. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening at nearest mortar joint.
- BB. Do not install flush mounting box back-to-back in walls; provide minimum 12 inches (300 mm) horizontal separation. Provide minimum 24 inches (600 mm) horizontal separation in acoustic rated walls.
- CC. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- DD. Properly support boxes with approved methods.
- EE. Install flush mounting box without damaging wall insulation or reducing its effectiveness. AF. Use properly supported, adjustable steel channel fasteners for hung ceiling outlet box.
- FF. Do not fasten boxes to ceiling support wires.
- GG. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches (305 mm) of box.
- HH. Use gang box where more than one device is mounted together. Do not use sectional boxes.
- II. Use 4" square box with plaster ring for single device outlets.
- JJ. Use cast outlet box, FS type, in exterior locations and wet locations. AL. Set floor boxes level.

KK. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

LL. Handholes shall be installed per detail on drawings.

3.3 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

3.4 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.5 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

B. Clean exposed surfaces and restore finish.

END OF SECTION 260537

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Underground warning tape.
- E. Field-painted identification of conduit.

1.2 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 260534 - Conduit.
- C. Section 262416 - Panelboards.
- D. Section 262717 - Equipment Wiring.
- E. Section 262736 – Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.

1.3 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace; 2021.

1.4 QUALITY ASSURANCE

- A. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.
- B. Conform to requirements of NFPA 70 and NFPA 70E.

1.5 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 - PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - 2. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - 3. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equal.
- B. Identification for Conductors and Cables:
 - 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
 - 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
- C. JUNCTION BOX COVERPLATE COLOR CODING:
 - 1. Junction box coverplates shall be color-coded to indicate function.
 - a. Emergency circuit homerun coverplates - WHITE.
 - b. Fire Alarm system coverplates - RED.
 - c. Telephone and Data system coverplates - BLUE.
 - 2. External surface of coverplate may be painted in unfinished spaces, and above accessible ceilings. The inside surface of the coverplate shall be painted for boxes located in finished spaces.
 - 3. In addition to color coding, the voltage of the homerun circuits shall be stenciled on to the box cover, indicating 208Y/120V or 480Y/277V.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 - 1. Manufacturers:
 - a. Brimar Industries, Inc: www.brimar.com/.
 - b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/.
 - c. Seton Identification Products: www.seton.com/.
 - d. Substitutions: See Section 016000 - Product Requirements.

2. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.
- B. Identification Labels:
 1. Manufacturers:
 - a. Brady Corporation: www.bradyid.com/ .
 - b. Brother International Corporation: www.brother-usa.com/ .
 - c. Panduit Corp: www.panduit.com/ .
 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Contractor MUST coordinate faceplate/block labeling scheme with Owner. Owner will provide additional labeling information to contractor after contract is awarded.
- D. Faceplates and punchdown blocks must be machine labeled.
- E. Nameplates: Engraved three-layer laminated plastic, white letters on black background. Use white letters on red background for equipment on Emergency power.
- F. Equipment to have Nameplates include:
 1. Panelboards, distribution panels, special system control panels, motors, motor starters, and, pushbutton stations.
 2. Normal use light switches will not require identification unless specifically noted otherwise.
 3. All receptacles shall be labeled with panel name and circuit number.
- G. Letter Size:
 1. Use 1/8 inch (3 mm) letters for identifying individual equipment and loads.
 2. Use 1/4 inch (6 mm) letters for identifying grouped equipment.
- H. Identification Labels:
 1. Equipment to have Identification Labels include:
 - a. All receptacles, pilot lights, special lighting or control switches, communication system pull boxes and junction boxes, and empty conduits provided for future use.
- I. Identification Label format for receptacles, pilot lights, special lighting or control switches:
 1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
 2. Legend: Power source and circuit number or other designation indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch (5 mm).
 5. Color: Black text on clear background.
- J. Identification Label format for communication system pull boxes and junction boxes, and empty conduits provided for future use:
 1. Minimum Size: 1/2 inch (13 mm) by 1.5 inches (38 mm).
 2. Legend: Source for Communications and Power source and circuit number for power circuits.
 - a. Include voltage and phase for other than 120 V, single phase circuits.

3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch (6 mm).
5. Color: Black text on clear background.

2.3 WIRE AND CABLE MARKERS

- A. Manufacturers:
 1. Brady Corporation: www.bradyid.com/.
 2. HellermannTyton: www.hellermannntyton.com/.
 3. Panduit Corp: www.panduit.com/.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch (3 mm).
- F. Color: Black text on white background unless otherwise indicated.
- G. Locations: Each conductor at panelboard gutters, pull boxes, and junction boxes for each load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams.
- H. Communication cable shall be provided with indelible, permanent identification labels on both ends. Coordinate with Owner to verify proper identification scheme.

2.4 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 1. Brady Corporation: www.bradyid.com/.
 2. Brimar Industries, Inc: www.brimar.com/.
 3. Seton Identification Products: www.seton.com/.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Materials: Use 4-inch wide foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise noted.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:
 1. Tape for Buried Power Lines: Black text on red background.
 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.
- B. Degrease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door when located in finished areas. Mount on outside of door when installed in electrical, mechanical, custodial or similar rooms.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Interior Components: Legible from the point of access.
 - 6. Boxes: Outside face of cover.
 - 7. Conductors and Cables: Legible from the point of access.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. All junction boxes shall be legibly and permanently marked to indicate the circuit numbers associated with the conductors in the junction box.
- G. Each new panelboard or existing panelboard with circuits provided under this project shall be provided with a neatly typed circuit directory with plastic protector.

3.3 FIELD QUALITY CONTROL

- A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 260553

SECTION 260919 – ENCLOSED CONTACTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General purpose contactors.
- B. Lighting control contactors.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 262813 - Fuses.
- E. Section 265100 - Interior Lighting
- F. Section 265600 - Exterior Lighting

1.3 REFERENCE STANDARDS

- A. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
- B. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (R2011).
- C. General purpose contactors.

1.4 SUBMITTALS

- A. See Division 01 and Section 260030 for submittal procedures.
- B. Product Data: Provide dimensions, size, voltage ratings and current ratings.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Allen-Bradley/Rockwell Automation: www.ab.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- D. Tork.
- E. Intermatic.
- F. Paragon.
- G. Substitutions: See Section 016000 - Product Requirements.

2.2 GENERAL PURPOSE CONTACTORS

- A. Description: NEMA ICS 2, AC general purpose magnetic contactor.
- B. Coil operating voltage: 120 volts, 60 Hertz, voltage as scheduled or as needed.
- C. Poles: As required to match circuit configuration and control function.
- D. Enclosure: NEMA ICS 6, Type 1.
- E. Accessories:
 - 1. Selector Switch: ON/OFF/AUTOMATIC.
 - 2. Indicating Light: RED.
 - 3. Auxiliary Contacts: Two, field convertible.

2.3 LIGHTING CONTACTORS

- A. Lighting contactors shall be equal to GE CR460 series for up to 30A or CR360 series for amperages over 30A.
- B. Description: NEMA ICS 2, magnetic lighting contactor.

- C. Configuration: Electrically held.
- D. Coil operating voltage: 120 volts, 60 Hertz, voltage as scheduled or needed.
- E. Poles: As required to match circuit configuration and control function.
- F. Contact Rating: 600VAC, 30A current rating.
- G. Enclosure: NEMA ICS 6, Type 1.
- H. Accessories:
 - 1. Selector Switch: ON/OFF/AUTOMATIC.
 - 2. Indicating Light: RED.
 - 3. Auxiliary Contacts: Two, field convertible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed contactors where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed contactors plumb. Provide supports in accordance with Section 260529.
- C. Provide engraved plastic nameplates; refer to Section 260553 for product requirements and location.

3.2 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 014000.

END OF SECTION 260919

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Distribution panelboards (power panelboards).
- B. Lighting and appliance panelboards.

1.2 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Power Conductors and Cables (600V and Less).
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260534 - Conduit.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- G. Section 262200 - Low-Voltage Transformers.
- H. Section 264300 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NECA 407 - Standard for Installing and Maintaining Panelboards; 2009.
- C. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches; National Electrical Manufacturers Association; 1993.
- D. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.

- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 70E - Standard for Electrical Safety in the Workplace; 2021.
- I. UL 67 - Panelboards; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Division 01 and Section 260030 for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories. Dimensions of Equipment.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 MAINTENANCE MATERIALS

- A. See Section 260032 - Product Requirements, for additional provisions.
- B. Furnish two of each panelboard key.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. ABB/GE : electrification.us.abb.com/
- B. Eaton Corporation : www.eaton.com/
- C. Schneider Electric; Square D Products : www.schneider-electric.us/
- D. Siemens Industry, Inc: www.usa.siemens.com/
- E. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ALL PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled by Underwriter Laboratories Inc. or other NTRL as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 7,500 feet (2,300 m).
 - 2. Ambient Temperature:

- a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
- C. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- D. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- E. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 - 2. Provide 200 percent rated neutral bus and lugs where oversized neutral conductors are provided.
 - 3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- F. Conductor Terminations: Suitable for use with the conductors to be installed.
- G. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- H. Load centers are not acceptable.

2.3 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Manufacturer/Product: Square D I-Line Distribution Panel or equal.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Copper.
 - 2. Ground Bus Material: Copper.
 - 3. Provide 200% neutral bus in panels as scheduled or when fed by K rated transformers.
- D. Minimum integrated short circuit rating unless specifically noted on schedules:
 - 1. 208Y/120 Volt Panelboards: Minimum 22,000 amperes rms symmetrical.
 - 2. 480Y/277 Volt Panelboards: Minimum 18,000 amperes rms symmetrical.
- E. Solid-State Molded Case Circuit Breaker: For circuit breakers as indicated on one-line diagram in Distribution Panel, provide devices with electronic sensing, timing and tripping circuits for adjustable current settings. Basic features shall include:
 - 1. Adjustable long time, short time, instantaneous trip.
 - 2. Stationary mounting.
- F. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole, bolt-on type, with common trip handle for all poles; UL listed. For air conditioning

equipment branch circuits provide circuit breakers UL listed as Type HACR. For branch circuits to HID lighting fixtures provide circuit breakers UL listed for HID use.

G. Enclosures:

1. NEMA PB 1, Type 1, [12] inches ([153] mm) deep maximum, [48] inches ([508] mm) wide maximum cabinet box.
2. Cabinet Front: Surface type, fastened with concealed trim clamps, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Manufacturer/Product: Square D Type NQ or Type NF depending on voltage or equal.

C. Bussing:

1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Copper.
3. Ground Bus Material: Copper.
4. Provide 200% neutral bus in panels as scheduled or when fed by K rated transformers.

D. Minimum Integrated Short Circuit Rating unless specifically noted on schedules:

1. 208Y/120 Volt Panelboards: Minimum 22,000 amperes rms symmetrical.
2. 480Y/277 Volt Panelboards: Minimum 18,000 amperes rms symmetrical.

E. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for all poles; UL listed.

1. Type SWD for lighting circuits.
2. Type HID for HID lighting circuits.
3. Type HACR for air conditioning equipment circuits.
4. Class A ground fault interrupter circuit breakers where scheduled.
5. Do not use tandem circuit breakers.
6. Provide shunt trip breakers as shown on drawings.

F. Enclosures:

1. Enclosure: NEMA PB 1, Type 1.
2. Provide surface-mounted or flush-mounted enclosures as indicated.
3. Cabinet Box: 6 inches (153 mm) deep, 20 inches (508 mm) wide for all panelboards.
4. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
5. Provide clear plastic circuit directory holder mounted on inside of door.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports and attachments in accordance with Section 260529.
- E. Install panelboards plumb.
- F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.
- H. Provide grounding and bonding in accordance with Section 260526.
- I. Install all field-installed branch devices, components, and accessories.
- J. Provide filler plates to cover unused spaces in panelboards.
- K. Provide typed circuit directory for each lighting and appliance panelboard and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces.
- L. Provide identification nameplate for each power distribution panelboard branch device in accordance with Section 260553, clearly and specifically indicating the loads served.
- M. Provide identification nameplate for each panelboard in accordance with Section 260553.
- N. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Quantity of spare conduits shall be one (1) 3/4" conduit for every three (3) spares/spaces, or fraction thereof. Identify each as SPARE.
 - 1. Minimum spare conduits: 4 empty 3/4 inch (19mm).

- O. Ground and bond panelboard enclosure according to Section 260526.
- P. For all panelboards, provide NFPA 70-2023 Art 110.24 Available Fault Current markings. The Available Fault Current markings may be either field or factory applied.
- Q. For all panelboards, provide NFPA 70-2023 Art 110.21(B) compliant hazard markings (Arc Flash and Shock Hazard). The hazard markings may be either field or factory applied.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- C. Test GFCI circuit breakers to verify proper operation.
- D. Test shunt trips to verify proper operation.
- E. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262416

SECTION 262716 - CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hinged cover enclosures.
- B. Cabinets.
- C. Terminal blocks.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding.
- B. Section 260529 - Hangers and Supports for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA ICS 4 - Application Guideline for Terminal Blocks; 2015.

1.4 SUBMITTALS

- A. See Division 01 and Section 260030 for submittal procedures.
- B. Product Data: Provide manufacturer's standard data for enclosures and cabinets.
- C. Cabinet Keys: Deliver to Owner in accordance with Section 016000 for maintenance materials.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250, Type 1 (3R where installed outdoors or exposed to moisture) steel enclosure.
- B. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.
- C. Provide interior plywood panel for mounting terminal blocks and electrical components; finish with white enamel.
- D. Enclosure Finish: Manufacturer's standard enamel.
- E. Keys: Provide two of each different key.

2.2 CABINETS

- A. Boxes: Galvanized steel.
- B. Backboard: Provide 3/4 inch (19 mm) thick plywood backboard for mounting terminal blocks and electrical components. Paint matte white.
- C. Fronts: Steel, surface type with screw cover front, door with concealed hinge, and flush lock . Finish with gray baked enamel.
- D. Provide metal barriers to form separate compartments wiring of different systems and voltages.
- E. Keys: Provide two of each different key.

2.3 TERMINAL BLOCKS

- A. Terminal Blocks: NEMA ICS 4.
- B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- C. Provide ground bus terminal block, with each connector bonded to enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner under the provisions of Section 260529.
- C. Install cabinet fronts plumb.

3.2 CLEANING

- A. Clean electrical parts to remove conductive and harmful materials.
- B. Remove dirt and debris from enclosure.
- C. Clean finishes and touch up damage.

END OF SECTION 262716

SECTION 262717 - EQUIPMENT WIRING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).
- B. Section 260526 - Grounding and Bonding.
- C. Section 260534 - Conduit.
- D. Section 260537 - Boxes.
- E. Section 260553 - Identification for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.5 SUBMITTALS

- A. See Division 01 for submittal procedures.

- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 COORDINATION

- A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Flexible Conduit: As specified in Section 260534.
- C. Wire and Cable: As specified in Section 260519.
- D. Boxes: As specified in Section 260537.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 262717

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Occupancy sensors.
- D. Receptacles.
- E. Wall plates.
- F. Cord and plugs for plug connected equipment.

1.2 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).
- B. Section 260526 - Grounding and Bonding.
- C. Section 260534 - Conduit.
- D. Section 260537 - Boxes.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 262717 - Equipment Wiring: Cords and plugs for equipment.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- D. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- E. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.

- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- H. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- I. UL 943 - Ground-Fault Circuit-Interruptioners; Current Edition, Including All Revisions.
- J. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
 - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 5. Notify Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Division 013330 and Section 260030 for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Operation and Maintenance Data:
 - 1. Wall Dimmers: Include information on operation and setting of presets.
 - 2. Occupancy Sensors: Include information on operation and setting of presets.
 - 3. GFCI Receptacles: Include information on status indicators and testing procedures and intervals.
- E. Project Record Documents: Record actual installed locations of wiring devices.

- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
 - 3. Extra Wall Plates: 20 of each style, size, and finish.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 - PRODUCTS

2.1 ALL WIRING DEVICES

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- B. Finishes:
 - 1. Wiring Devices Installed in Finished Spaces: White with stainless steel wall plate unless otherwise indicated.
 - 2. Wiring Devices Installed in Unfinished Spaces: Gray with stainless steel wall plate unless otherwise indicated.
 - 3. Wiring Devices Installed in Wet or Damp Locations: Gray with specified weatherproof cover unless otherwise indicated.
 - 4. Wiring Devices Connected to UPS Power: Red with stainless steel wall plate.
 - 5. Wiring Devices Connected to Generator Power: Gray with stainless steel wall plate.
 - 6. All ceiling mounted occupancy sensors shall be White.

2.2 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/ .
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com/ .
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/ .
 - 4. Arrow Hart, a brand of Eaton. www.eaton.com/us/en-us/products/wiring-devices-connectivity/arrow-hart.html
 - 5. Sensor Switch, a brand of Acuity Brands Lighting, Inc: www.acuitybrands.com.

- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three-way, or four-way as indicated on the drawings.
 - 1. Product: Hubbell No. HBL1221W Series or equal.
- D. Occupancy Sensor Wall Switch Style:
 - 1. Product: Sensor Switch #WSD-V-WH, or equal. Switch will require manual on and will provide automatic (predictive) off.
- E. Occupancy Sensor Ceiling Mounted:
 - 1. Product: Sensor Switch #CMR-PDT-9 or equal.
 - 2. Large Areas Requiring multiple sensors: Product: Sensor Switch #CM-PDT-10 with #PP-20 power pack, or equal.
- F. Combination Occupancy Sensor – Dimmer Wall Switch Style:
 - 1. Product: Sensor Switch #WSX-PDT-D-WH, or equal. Switch will require manual on and will provide automatic (predictive) off. Provide compatible switch for specific LED driver as applicable.

2.3 WALL DIMMERS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/ .
 - 2. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/ .
 - 3. Leviton Manufacturing Company, Inc: www.leviton.com/ .
 - 4. Lutron Electronics Company, Inc; Diva Series: www.lutron.com/ .
 - 5. Sensor Switch, a brand of Acuity Brands Lighting, Inc: www.acuitybrands.com
- B. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
- C. Wall Dimmers: NEMA WD 1; Semiconductor dimmer for LED lamps, Type as indicated on drawings, or as required to be compatible with LED driver and device boards.
 - 1. Voltage: 120 or 277 volts, as required.
 - 2. Product: Diva series by Lutron Corporation or approved equal. MUST be compatible with lamps and ballasts.

2.4 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/ .

2. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/ .
 3. Leviton Manufacturing Company, Inc: www.leviton.com/ .
 4. Arrow Hart, a brand of Eaton. www.eaton.com/us/en-us/products/wiring-devices-connectivity/arrow-hart.html
- B. All Receptacles: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 2. NEMA configurations specified are according to NEMA WD 6.
 3. Provide labeling of receptacles as outlined in Section 260553.
- C. Convenience Receptacles:
1. Standard Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 - a. Pass & Seymour #CR20W, Hubbell #5362W or equal.
 2. Tamper-Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, , listed and labeled as tamper-resistant type; single or duplex as indicated on the drawings.
 - a. Pass & Seymour #TR20W, Hubbell #BR20WHITR or equal.
- D. GFCI Receptacles:
1. All GFCI Receptacles: Provide with feed-through protection, light to indicate ground fault tripped condition and loss of protection, and list as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 2. Standard GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 - a. Hubbell #GFRST20W or equal.
 3. Tamper-Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper-resistant type.
 - a. Pass & Seymour #2097TRW, Hubbell #GFTRST20W or equal.
 4. Tamper-Resistant and Weather-Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper-resistant type and as weather-resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
 - a. At all outdoor receptacle locations: Pass & Seymour #2097TRWRGRY, Hubbell #GFTWRST20GY or equal.
- E. Special purpose receptacles, as noted or shown on the drawings.

2.5 WALL PLATES

- A. Manufacturers:
1. Hubbell Incorporated: www.hubbell-wiring.com/ .
 2. Leviton Manufacturing Company, Inc: www.leviton.com/ .
 3. Lutron Electronics Company, Inc: www.lutron.com/ .
 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/ .

5. Arrow Hart, a brand of Eaton. www.eaton.com/us/en-us/products/wiring-devices-connectivity/arrow-hart.html
 6. Sensor Switch, a brand of Acuity Brands Lighting, Inc: www.acuitybrands.com.
 7. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. All Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard.
 3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Stainless Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
- D. Weatherproof While-In-Use Covers: Single gang, vertical mount. Self-closing and weatherproof (gasketed) with cord and plug inserted into the device. Extra Duty, commercial quality die-cast aluminum cover with factory powered coated finish. Integral cord catch and hole to accept a standard size padlock, 302 Stainless Steel mounting screws. Product: Hubbell TayMac MX3200 or approved substitution.

2.6 CORD AND PLUGS

- A. Provide cord and plugs for all plug connected equipment as required. Provide cord sets for new cord & plug connected equipment in the Laboratory areas, per manufacturer's recommendations, as shown and scheduled on the plans. Cord and plug connected equipment includes laboratory equipment noted on the plans.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260537 as required for installation of wiring devices provided under this section.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
- J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- K. Install wall switches with OFF position down.
- L. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

- O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- P. Identify wiring devices in accordance with Section 260553.
- Q. Install receptacles with grounding pole oriented to the top.
- R. Connect wiring device grounding terminal to outlet box with bonding jumper, except where equipment grounding conductor is present.
- S. Connect wiring devices by wrapping conductor around screw terminal.
- T. Use jumbo size plates for outlets installed in masonry walls.
- U. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- V. Install protective rings on active flush cover service fittings.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 260537 to obtain mounting heights specified or indicated on drawings.
- B. Install wall switch 46 inches (1.17 m) above finished floor.
- C. Install convenience receptacle 18 inches (450 mm) above finished floor or as indicated on plans.
- D. Install convenience receptacle 6 inches (150 mm) above counter.
- E. Install wall dimmers 46 inches (1.17 m) above finished floor.
- F. Install telephone and data jacks 18 inches (450 mm) above finished floor or as indicated on plans.
- G. Install telephone jack for all wall telephone and intercom outlets at 46 inches (1.17 m) above finished floor.
- H. All electrical devices in warehouse area shall be installed a minimum of 24 inches (.61m) above finished floor or as indicated on plans.
- I. Heights above are to the center of the box.

3.5 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting in accordance with Section 014000.
- B. Inspect each wiring device for damage and defects.

- C. Operate each wall switch with circuit energized to verify proper operation.
- D. Operate each wall switch with circuit energized and verify proper operation.
- E. Verify that each receptacle device is energized.
- F. Test each receptacle to verify operation and proper polarity.
- G. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- H. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust devices and boxes as required to assure that device coverplates seat firmly to wall surface.

3.7 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fuses.
- B. Fuse cabinet and spare fuses.

1.2 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 262818 - Enclosed Switches: Fusible switches.

1.3 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - a. Fusible Enclosed Switches: See Section 262818.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Division 01 and Section 260030 for submittal procedures.
- B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
 - 1. Spare Fuse Cabinet: Include dimensions

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 MAINTENANCE MATERIALS

- A. See Section 260032 - Product Requirements, for additional provisions.
- B. Furnish one fuse puller for each type of fuse.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/ .
- B. Littelfuse, Inc: www.littelfuse.com/ .
- C. Mersen: ep-us.mersen.com/ .
- D. Substitutions: See Section 016000 - Product Requirements.

2.2 APPLICATIONS

- A. Individual Motor Branch Circuits: Class RK1, time-delay.

2.3 FUSES

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.

- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.

2.4 FUSE CABINET AND SPARE FUSES

- A. Provide one spare fuse cabinet Bussman "SPC" or equal. The cabinet shall contain fuse puller and all applicable spare fuses with labels identifying type and size. Cabinet shall be provided with hinged door and latch.
- B. Provide one spare fuse for each three fuses of each amp rating installed with a minimum of three spares for each amp rating used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet where directed by Owner.

END OF SECTION 262813

SECTION 262818 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Enclosed safety switches.
- B. Fusible switches.
- C. Nonfusible switches.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 262813 - Fuses.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- C. NECA (INST) - NECA Standard of Installation; National Electrical Contractors Association; 1993.
- D. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Division 01 and Section 260030 for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Project Record Documents: Record actual locations of enclosed switches.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 7,500 feet (2,300 m).
 - 2. Ambient Temperature: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
- D. Horsepower Rating: Suitable for connected load.

- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- H. Provide with switch blade contact position that is visible when the cover is open.
- I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
- J. Conductor Terminations: Suitable for use with the conductors to be installed.
- K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
- M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- N. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

2.3 COMPONENTS

- A. Fusible Switch Assemblies: NEMA KS 1, Type HD (heavy-duty) enclosed load interrupter knife switch.
 - 1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
 - 2. Handle lockable in OFF position.
 - 3. Fuse clips for Main Disconnect Switches: Designed to accommodate NEMA FU1, Class L fuses.
 - 4. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.
- B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD (heavy-duty) enclosed load interrupter knife switch.
 - 1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
 - 2. Handle lockable in OFF position.

- C. Enclosures: NEMA KS 1.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior or Wet Locations: Type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. All disconnect switches shown on drawings shall be considered fused unless specifically noted as non-fused.
- B. Install enclosed switches in accordance with manufacturer's instructions.
- C. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required supports in accordance with Section 260529.
- F. Install enclosed switches plumb.
- G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.
- H. Provide grounding and bonding in accordance with Section 260526.
- I. Provide fuses complying with Section 262813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- J. Provide identification nameplate for each enclosed switch in accordance with Section 260553.
- K. Provide arc flash warning labels in accordance with NFPA 70.
- L. Install fuses in fusible disconnect switches, with fuse nameplates visible from the front.

- M. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.3 FIELD QUALITY CONTROL

- A. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

END OF SECTION 262818

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Combination magnetic motor controllers and disconnects.
- B. Variable Frequency Drives
- C. Disconnect Switch.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches; National Electrical Manufacturers Association; 1993.
- C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
- D. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2000 (R2010).
- E. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. See Division 01 and Section 260030 for submittal procedures.
- B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

- C. Maintenance Data: Replacement parts list for controllers.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 150 miles (241 km) of Project.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Same as panelboards or Allen-Bradley.

2.2 VARIABLE FREQUENCY DRIVES

- A. Variable frequency drives (VFD's) are being provided as indicated on Motor and Starter schedule. Coordinate requirements with Mechanical Contractor.
 - 1. Where VFD's are noted to be supplied by the Mechanical Contractor with equipment the Electrical Contractor shall ensure they are installed and wired properly.
 - 2. Provide motor shaft grounding of all motors served by VFD's in accordance with Section 260526 Grounding and Bonding. This is required of all VFD's whether supplied by the Electrical Contractor or not.

2.3 ACCESSORIES FOR ALL AUTOMATIC CONTROLLERS

- A. Auxiliary Contacts: NEMA ICS 2, 2 field convertible contacts in addition to seal-in contact.
- B. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oiltight type. Provide red RUN and green OFF LED lights.
- C. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
- D. Pushbuttons: Recessed type.
- E. Indicating Lights: Transformer, LED type.
- F. Selector Switches: Rotary type. Cover mounted HOA.
- G. Control Power Transformers: 24 volt secondary, 120V primary or as needed. Provide fused primary, secondary, and bond unfused leg of secondary to enclosure.

2.4 DISCONNECTS

- A. Combination Controllers: Combine motor controllers with over-current protective device and disconnect in common enclosure. Obtain IEC Class 2 coordinated component protection.
- B. Motor Circuit Protector: Circuit breakers with integral instantaneous magnetic trip in each pole; UL listed. Shall be provided in all combination controllers.
- C. Nonfusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.
- B. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
- C. Provide supports in accordance with Section 260529.
- D. Height: 5 ft (1500 mm) to operating handle.
- E. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- F. Provide engraved plastic nameplates; refer to Section 260553 for identification requirements and location. Shall identify motor served, horsepower of motor, and voltage/phase rating.

3.2 FIELD QUALITY CONTROL

- A. Correct deficiencies and replace damaged or defective enclosed controllers or associated components.

3.3 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.4 CLEANING

- A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

SHERIDAN COUNTY SCHOOL DISTRICT NO. 2
SHS FAMILY CONSUMER SCIENCE RENOVATION
2023-70

ARETE DESIGN GROUP
MARCH 21, 2024
100% CONSTRUCTION DOCUMENTS

END OF SECTION 262913

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Exit signs.
- C. Emergency Lighting Relay.
- D. LED lighting systems.
- E. Luminaire accessories.

1.2 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Power Conductors and Cables (600V and Less).
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260534 - Conduit.
- D. Section 260537 - Boxes.

1.3 REFERENCE STANDARDS

- A. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2006.
- D. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- E. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 101 - Life Safety Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction.

- H. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- I. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- J. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013330 and Section 260030 for submittal procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
- D. Shop drawing submittals for luminaires shall be complete in all aspects and at a minimum shall contain, but are not limited to, the following: (1) Luminaire cutsheet, (2) Ballast or LED driver board cutsheet, (3) Integral emergency ballast/battery pack or LED driver board/battery pack cutsheet (as applicable to the project) and (4) Lamps or LED device board cutsheet. In addition, Shop Drawing submittals for luminaires shall have a complete luminaire schedule included at the front of the submittal which shall, at a minimum, include the following technical data: manufacturer, model number, lumens (LM), watts (W) and lumens/watt (LPW).
- E. All luminaires shall be DLC LISTED, no exceptions. If luminaire is not DLC LISTED do not submit for prior approval. Should product be submitted as being listed and later found to not be on the DLC list, the lighting supplier shall provide a DLC LISTED luminaire to meet project requirements and in the timeframe not impeding project progress or cost.
- F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70 and NFPA 101.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- C. Electrical Components: Listed and classified by Underwriters Laboratories Inc. or other organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) as suitable for the purpose specified and indicated. NRTL must also be acceptable to Authority Having Jurisdiction (AHJ).

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.7 WARRANTY

- A. See Section 260032 - Product Requirements, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all LED luminaires, including drivers.

1.8 EXTRA MATERIALS

- A. See Section 260032 - Product Requirements, for additional provisions.
- B. Furnish 2% or a minimum of 2 of each LED driver board and LED device board. Emergency battery packs are not included. Luminaire manufacturer shall keep reasonable LED driver board and LED device board stocks on hand for replacement during warranty period.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Furnish products as indicated in Luminaire Schedule included on the Drawings.
- B. All luminaires shall be provided with a disconnecting means meeting the requirements of the NEC.

2.2 EXIT SIGNS

- A. All Exit Signs: Internally illuminated with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single or double as indicated or as required for the installed location.
 - 2. Directional Arrows: As indicated or as required for the installed location.

2.3 LED LIGHTING SYSTEMS

- A. General: All LED lighting system components must be UL or other NRTL listed.
- B. Engines/lamps:

1. Meets or exceeds 70% lumen maintenance at 50,000 hours based on IESNA LM-79-2008.
 2. Minimum 80+ CRI rating.
 3. Color Temperature as scheduled on drawings.
 4. Minimum delivered lumens as scheduled on drawings.
 5. Minimum Luminous Efficacy as scheduled on drawings.
- C. LED Electronic Drivers:
1. Factory installed.
 2. Multi-volt for use on either 120VAC or 277VAC systems.
 3. THD: <10%.
 4. Factory installed quick-disconnect plug internal to the luminaire for driver removal.
 5. Rated for a minimum of 50,000 hours.
 6. 0-10VDC dimming standard. Provide non-dimming drivers only as scheduled on drawings.
 - a. Controls and wiring as per manufacturer's recommendations. Provide power packs for wall-box dimmers as required for positive luminaire off.
- D. Emergency battery packs:
1. Include self-testing/self-diagnostics with audible alarm option.
 2. Factory installed.
 3. Minimum delivered lumens as scheduled on drawings.

2.4 EMERGENCY LIGHTING RELAY

- A. Manufacturer: Nine 24, Inc. Model BLTC-R or equal by Bodine.
- B. Description: Self-contained power supply and low voltage relay in a thermoplastic housing designed to override switches in case of normal utility power failure. UL 924 listed.
- C. Rating: 120VAC, 10A.
- D. Local test switch with LED indicators for normal and emergency power. Mounts to a standard junction box. Mount test switch and LED indicator flush in ceiling near relay.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products according to manufacturer's instructions.
- B. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA 500 (commercial lighting).
- C. Install suspended luminaires and exit signs using pendants supported from swivel hangers or by chain as indicated in schedule. Provide pendant length or chain required to suspend luminaire at indicated height.

- D. Support luminaires independent of ceiling frame.
- E. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- F. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- G. Install recessed luminaires to permit removal from below.
- H. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Install clips to secure recessed grid-supported luminaires in place.
- J. Install wall mounted luminaires and exit signs at height as indicated on Drawings.
- K. Install accessories furnished with each luminaire.
- L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within fixture; use flexible conduit.
- M. Connect luminaires to branch circuit outlets provided under Section 260537 as indicated.
- N. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- O. Bond products and metal accessories to branch circuit equipment grounding conductor.
- P. Install specified lamps in each luminaire.
- Q. 0-10VDC LED Dimming Control Circuits
 - 1. Installed in accordance with NEC Article 725.
 - 2. Class 1 systems
 - a. #14 AWG THWN/THHN solid conductors installed in same raceway as associated power wiring.
 - 3. Class 2 systems
 - a. #18/2 non-shielded cable unless otherwise indicated on the drawings.
 - b. Plenum rated where required.
 - c. Cable shall be installed in raceway when concealed within walls, in mechanical or electrical rooms, or any room without a ceiling.
 - 1) DO NOT INSTALL IN SAME RACEWAY AS POWER CIRCUITRY.
 - d. Cable not required to be enclosed in raceway when installed above accessible ceilings.
 - 1) Route cables parallel or perpendicular to building construction.
 - 2) Support cables from building structure utilizing approved methods.
 - 3) Neatly coil excess cable length of pre-terminated assemblies.
 - 4) All cable runs shall be continuous between devices. NO SPLICING.

3.2 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer.

3.3 ADJUSTING

- A. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Engineer or authority having jurisdiction.
- B. Aim and adjust luminaires as directed by manufacturer and Engineer.

3.4 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

3.5 CLOSEOUT ACTIVITIES

- A. Replace luminaires that have failed LED driver board or LED device board at Substantial Completion. Replacement shall not come from Owner spare stock.
- B. Demonstration: Demonstrate proper operation of luminaires to Engineer, and correct deficiencies or make adjustments as directed.

END OF SECTION 265100

SECTION 270010 - SUPPLEMENTAL REQUIREMENTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 27.

B. Related Requirements:

1. Section 013100 "Project Management and Coordination" for preinstallation conference procedures.
2. Work specified in the following Division 26 sections are related to Work specified in Division 27:
 - a. Section 260030 "Administrative Requirements" for abbreviations and acronyms for electrical terms and units of measure, abbreviations and acronyms for electrical raceway types, abbreviations and acronyms for electrical cable types, definitions, and additional coordination drawing submittal requirements.

1.2 REFERENCES

A. Definitions for Communications:

1. Voice over Internet Protocol (VoIP): Digital telephone packet technology that uses the internet for its transmission medium.

1.3 COORDINATION

- A. Coordinate with the owner's technology representative for equipment location, layout and identification requirements.
- B. Coordinate installation of utility conduits with utility provider prior to installation.
- C. Coordinate device placement with electrical and other trades to ensure devices are located consistent the intent of the drawings.

1.4 PREINSTALLATION MEETINGS

- A. Communications Preconstruction Conference: Schedule conference with Architect and Owner not later than 30 days after notice to proceed. Agenda topics include, but are not limited to, the following:

1. Installation schedule for communications systems.
2. Utility services work coordination and monitoring service requests.
3. Commissioning activities.

1.5 ACTION SUBMITTALS

- A. Coordination Drawings: Submit drawings depicting communications equipment, racks with supporting accessories, device locations, cable routing, and cable tray, and conduit requirements.

1.6 INFORMATIONAL SUBMITTALS

- A. Installation schedule for communications systems.
- B. Qualification statements.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 1. Include product data for all products provided.
 2. Provide cable test reports including tester used. Report shall indicate "PASSED" in accordance with the appropriate standards.
- B. As-Built Drawings showing device locations, device labels, and rack elevations.
- C. Software programming.

1.8 QUALITY ASSURANCE

- A. Qualifications: Prepare and submit qualification statements for the following entities performing Work on Project:
 1. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 014000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than eight hours.
 2. Communications Design Professional: Design professional possessing active qualifications specified in Section 014000 "Quality Requirements" and the following:
 - a. Expertise in design of communications infrastructure and distribution equipment.
 - b. BICSI Registered Communications Distribution Designer (RCDD) certification.
 3. Communications Cable Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" and the following:
 - a. Training and manufacturer certification to install, splice, and terminate communications cabling.

- b. Installation Supervisor: BICSI Technician (TECH) certification.
- c. Copper Installers: 30 percent of employees possess BICSI Copper Installer 2 (INSTC) certification. Remaining employees possess BICSI Installer 1 (INST1) certification.

B. Certifications:

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR COMMUNICATIONS EQUIPMENT

- A. Substitution requests for communications equipment will be entertained under the following conditions:
 - 1. Substitutions shall be submitted to the Architect and received by the Architect no later than 10 calendar days prior to the bid date. Any product that is approved for bidding will be included in the final addendum prior to bid date. Substitution requests received after the date indicated will not be considered and no response will be provided.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Installation Schedule for Communications Systems: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for installation of communications Work to Owner and Architect including, but not limited to, milestone dates for the following activities:
 - 1. Submission of specified coordination drawings.
 - 2. Submission of action submittals specified in Division 27.
 - 3. Orders placed for major equipment.
 - 4. Arrival of major equipment on-site.
 - 5. Preinstallation meetings specified in Division 27.
 - 6. Closing of walls and ceilings containing communications Work.
 - 7. System startup, testing, and commissioning activities for communications equipment.
 - 8. System startup, testing, and commissioning activities for Work specified in other divisions that depends on Work specified in Division 27.
 - 9. Requests for special inspections.
 - 10. Requests for inspections by authorities having jurisdiction.
- B. Protection of In-Place Conditions:
 - 1. All work installed shall be protected during construction. Items that have been affected by the construction process, including but not limited to damage, dust, debris, etc. shall be replaced or repair to the satisfaction of the Architect at the contractors expense.

3.2 INSTALLATION OF COMMUNICATIONS WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' instructions, comply with NFPA 70, NECA NEIS 1, and BICSI N1 for installation of Work specified in Division 27. Consult Architect for resolution of conflicting requirements.

3.3 SYSTEM STARTUP

- A. Schedule system startup with the owner's representative at a time acceptable to the owner and at least 30 day prior to the schedule startup.

3.4 FIELD QUALITY CONTROL

- A. Administrant for Communications Tests and Inspections:
 - 1. Administer and perform tests and inspections with assistance of factory-authorized service representative.

3.5 CLEANING

- A. Waste Management:
 - 1. Contractor shall be responsible for removal and proper disposal of all construction waste.

3.6 CLOSEOUT ACTIVITIES

- A. Operation and Maintenance Data: Prepare and submit the following:
 - 1. Include the following information:
 - a. Manufacturer's operating specifications.
 - b. User's guides for software and hardware.
 - c. Schedule of maintenance material items recommended to be stored at Project site.
 - d. Detailed instructions covering operation under both normal and abnormal conditions.
 - e. Manufacturer's instructions for setting field-adjustable components.
 - f. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
 - g. Include copies of demonstration and training videos.
- B. Software and Firmware Operational Documentation: Provide software and firmware operational documentation, including the following:
 - 1. Software operating and upgrade manuals.
 - 2. Names, versions, and website addresses for locations of installed software.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

5. Testing and adjusting of panic and emergency communications features.

C. Software:

1. Program Software Backup: Provide username and password for approved online or cloud solution and USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.
2. Provide to Owner upgrades and unrestricted licenses for installed and backup software, including operating systems and programming tools required for operation and maintenance.

D. Demonstration:

1. With assistance from factory-authorized service representatives, demonstrate to Owner's maintenance and clerical personnel and building occupants how to operate the following systems and equipment:
 - a. Education Intercommunications and Gym Sound Systems specified in Section 275123 "Education Intercommunications and Program Systems."

E. Training:

1. With assistance from factory-authorized service representatives, train Owner's maintenance personnel on the following topics:
 - a. How to adjust, operate, and maintain intercommunications and program system equipment specified in Section 275123 "Commercial Intercommunications and Program Systems," including programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining the system and equipment.

END OF SECTION 270010

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Metallic surface pathways.
3. Nonmetallic surface pathways.
4. Tele-power poles.
5. Hooks.
6. Polymer-concrete handholes and boxes for exterior underground cabling.

1.2 DEFINITIONS

- A. GRC: Galvanized rigid conduit.
- B. IMC: Intermediate metal conduit.
- C. RNC: Rigid nonmetallic polyvinyl chloride conduit.
- D. RTRC: Reinforced thermosetting resin conduit.

1.3 ACTION SUBMITTALS

A. Product data for the following:

1. Surface pathways
2. Wireways and fittings.
3. Tele-power poles.
4. Boxes, enclosures, and cabinets.
5. Underground handholes and boxes.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
3. Underground ducts, piping, and structures in location of underground enclosures and handholes.

- B. Seismic Qualification Data: Seismic rating for all pathway racks, enclosures, cabinets, equipment racks, and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
 - 2. Comply with TIA-569-D.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. RNC: Comply with NEMA TC-2 and UL651.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Set screw or compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

- H. Joint Compound for IMC, GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 HOOKS

- A. Description: Prefabricated sheet metal cable supports for telecommunications cable.
- B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- C. Comply with TIA-569-D.
- D. Galvanized steel.
- E. J shape, minimum 2”.

2.3 POLYMER-CONCRETE HANDHOLES

- A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.
- B. General Requirements for Polymer Concrete Handholes:
 - 1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 3. Comply with TIA-569-D and SCTE 77.
- C. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
- D. Cover: Traffic rated, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 2. Cover Legend: Molded lettering, "COMMUNICATIONS".
- E. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- F. Handholes 17 Inches Wide by 30 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 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 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC or IMC.
 2. Concealed Conduit, Aboveground: GRC, IMC or EMT.
 3. Underground Conduit: RNC, Type EPC-80-PVC,.
 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT, IMC or RNC identified for such use.
 3. Exposed and Subject to Severe Physical Damage: GRC or IMC. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 4. Concealed in non-accessible Ceilings and Interior Walls and Partitions: EMT.
 5. Concealed in accessible Ceilings: J-hooks space at not more than 48" O.C.
 6. Damp or Wet Locations: GRC or IMC.
 7. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway Riser-type, optical-fiber-cable pathway Plenum-type, optical-fiber-cable pathway General-use, communications-cable pathway Riser-type, communications-cable pathway Plenum-type, communications-cable pathway EMT or Cabletray.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 1-inch trade size for copper cables.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. EMT: Use set-screw or compression, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds [120 deg F].

3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA/BICSI 568.
 - 3. TIA-569-D.
 - 4. NECA 101
 - 5. NECA 102.
 - 6. NECA 105.
 - 7. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.
- E. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Pathways and Cabling" for sleeves and sleeve seals for communications.
- F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- G. Complete pathway installation before starting conductor installation.
- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Pathways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.

2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from nonmetallic conduit and fittings to GRC or IMC and fittings before rising above floor.
- M. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for pathways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
 3. Stub-ups shall have 90 degree bend at top so cable exits horizontally.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- S. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- T. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- U. Surface Pathways:
1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 2. Install surface pathway with a minimum 2-inch radius control at bend points.
 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 60 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

- V. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, 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 pathway-sealing fittings according to NFPA 70.
- W. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service pathway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- Y. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC[and EMT] that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Z. Hooks:
 - 1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
 - 2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.

3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
 4. Space hooks no more than 4 feet o.c.
 5. Provide a hook at each change in direction.
- AA. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- BB. 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. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- CC. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Set metal floor boxes level and flush with finished floor surface.
- GG. 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 Section 312000 "Earth Moving" for pipe of less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "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 of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

- a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete around conduit for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

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 level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 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 above finished grade.
- D. 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 enclosure.
- E. 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 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Pathways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Category 6A twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Multiuser telecommunications outlet assembly.
4. Cable management system.
5. Cabling identification products.
6. Grounding provisions for twisted pair cable.
7. Source quality control requirements for twisted pair cable.

1.2 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. FTP: Shielded twisted pair.
- D. F/FTP: Overall foil screened cable with foil screened twisted pair.
- E. F/UTP: Overall foil screened cable with unscreened twisted pair.
- F. IDC: Insulation displacement connector.
- G. LAN: Local area network.
- H. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- J. RCDD: Registered Communications Distribution Designer.
- K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- M. S/FTP: Overall braid screened cable with foil screened twisted pair.
- N. S/UTP: Overall braid screened cable with unscreened twisted pairs.

- O. UTP: Unscreened (unshielded) twisted pair.

1.3 RELATED REQUIREMENTS

- A. Section 260011 "Facility Performance Requirements for Electrical" field conditions including Seismic Hazard Design requirements.

1.4 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable cabling system shall provide interconnections between Main Distribution Frame and the equipment outlet, otherwise known as "Cabling system," in the telecommunications cabling system structure. The cabling system consists of horizontal cables, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
 - 1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
 - 2. Horizontal cabling shall contain no transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
 - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area outlet is one location with multiple cables for connection to the station equipment.
 - 1. Provide two cables to each outlet location shown on drawings unless noted otherwise.
 - a. Data/Voice Jacks, provide two cables for each outlet location terminated on a 4 port wall jack faceplates. Provide blank inserts for spare openings.
 - b. Wireless Access Point locations, provide two cables for each outlet location terminated on a biscuit jack with female RJ45 jack. Provide 10' of cable storage coiled in the ceiling space and supported with hook and loop strap mounted to the wall adjacent to the jack location.
 - c. Video Surveillance Camera locations, provide one cable for each camera location terminated on a biscuit jack with female RJ45 jack. Provide 10' of cable storage coiled in the ceiling space and supported with hook and loop strap mounted to the wall adjacent to the jack location.
 - 1) For outdoor camera locations, provide a 10' pre-terminated outdoor rated patch cord for each camera location.
 - 2) For indoor camera locations, provide a 1' pre-terminated patch cord for each camera location.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules:
 - a. Electronic copy of labeling schedules, in software and format.
 - 2. Cabling administration Drawings and printouts.
 - 3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
 - a. Telecommunications rooms plans and elevations.
 - b. Telecommunications pathways.
 - c. Telecommunications system access points.
 - d. Telecommunications grounding system.
 - e. Telecommunications conductor drop locations.
 - f. Typical telecommunications details.
- C. Twisted pair cable testing plan.
- D. Field Quality-Control Submittals:
 - 1. Field quality-control reports.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD, installation supervisor, and field inspector.
- B. Product Certificates: For each type of product.
- C. Source quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For all horizontal cabling system components including termination jacks, patch panels, wire managers, racks, cables and connectors shall be included in the maintenance manuals.
- B. Drawings: Provide one electronic copy of as-built drawings showing the following:
 - 1. Final rack layout showing installed components.
 - 2. Floor plan drawings showing each outlet location with the label of the installed devices.
 - 3. Major cable routing.
 - 4. Sleeve locations for fire rated sleeves.
- C. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On USB media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.8 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. Cover Plates: 10 each.
 - 2. Jacks: Ten of each type.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings, cabling administration Drawings, and field testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until 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.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers prior to installing any equipment. Provide meeting minutes with the results of the final layout and include any deviation from the drawing details.

1.13 WARRANTY FOR STRUCTURED CABLING SYSTEM

- A. Special Manufacturer System warranty: Structured cable system will be covered by a two-part certification program provided by a single manufacturer and that manufacturer's certified vendor. Manufacturer shall administer a follow-on program through the Vendor to provide support and service to the purchaser. The first part is an assurance program, which provides that the certified system will support the applications for which it is designed, during the 25-year warranty of the certified system.

- B. The second portion of the certification is a 25-year warranty provided by the manufacturer and the vendor on all products within the system (cords, telecommunications outlet/connectors, cables, cross-connects, patch panels, etc.).
- C. If the certified system ceases to support the certified application(s), whether at the time of cutover, during normal use or when upgrading, the manufacturer and vendor shall commit to promptly implement corrective action.
- D. Documentation proving the cabling system's compliance to the End-to-End Link Performance recommendations, as listed in ANSI/TIA-568-C shall be provided by the Vendor prior to the structured cabling system being installed.
- E. The cabling system must conform to the current issue of industry standard TIA-568. All performance requirements of this document must be followed. As well, workmanship and installation methods used shall be equal to or better than that found in the BICSI (Building Industry Consulting Service International) ITSIM manual.
- F. Purchaser demands strict adherence to the performance specifications listed in ANSI/TIA-568-C series standards.
- G. Manufacturer shall maintain ISO Quality Control registration for the facilities that manufacturer the product used in this cabling system.

PART 2 - PRODUCTS

2.1 MANUFACTURES

- A. Subject to compliance, products shall be provided by a single manufacturer that complies with the warranty requirements by the following.
 - 1. Panduit Corp.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard. Horizontal cabling system shall meet or exceed Category 6A system performance.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

2.3 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
 - 1. Communications, Non-Plenum Rated:

- a. Type CMP complying with UL 1666.
- B. RoHS compliant.

2.4 CATEGORY 6A TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6A cable at frequencies up to 550 MHz.
- B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6A cables.
- C. Conductors: 100-ohm, 23 AWG solid copper.
- D. Shielding/Screening: Unshielded twisted pairs (UTP).
- E. Cable Rating: Plenum.
- F. System: Mini-Com UTP RJ45 Cat 6A.
- G. Jacket color:
 - 1. Data: Blue.
 - 2. Wireless Access Point: Yellow.
 - 3. Clock/Intercom: White.
 - 4. HVAC: Black.

2.5 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect and terminate twisted pair copper communications cable.
- B. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.
- C. General Requirements for Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 6A.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
- D. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
 - 1. KeyConnect Patch Panel, 48-port, 1U, Black.
 - a. Provide 48 Cat 6A jacks.
 - b. Terminate on T568B.
 - c. 48 ports. Provide 20% spare capacity.

- E. Patch Cords: Factory-made, four-pair cables in lengths indicated; terminated with an eight-position modular plug at each end.
 - 1. Patch cords: 10GX Patch Cord, Bonded-Pair, 4-Pair, 23 AWG Solid.
 - 2. Patch cords at patch panels: 36 inch, blue.
 - 3. Provide three patch cords for every four jacks terminated.
- F. Jacks and Jack Assemblies:
 - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - 2. Designed to snap-in to a patch panel or cover plate.
 - 3. Standard: Comply with TIA-568-C.2.
 - 4. Marked to indicate transmission performance.
 - 5. Data Jacks: Blue.
- G. Cover Plate:
 - 1. Four port, vertical single gang cover plates designed to mount to single gang wall boxes.
 - 2. Plastic Cover Plate: High-impact plastic. Coordinate color with Section 260533 "Raceway and Boxes for Electrical Systems."
 - 3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
- H. Legend:
 - 1. Machine printed, in the field, using adhesive-tape label.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 SOURCE QUALITY CONTROL

- A. Factory test cables on reels according to TIA-568-C.1.
- 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 WIRING METHODS

- A. Routing:
 - 1. Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and attics where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.

- a. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."
- B. Comply with Section 270528 "Pathways for Communications Systems."
- C. Comply with Section 260529 "Hangers and Supports for Electrical Systems."
- D. Comply with Section 270536 "Cable Trays for Communications Systems."
- E. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
 - 2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
 - 5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets and patch panels.
 - 6. MUTOA shall not be used as a cross-connect point.
 - 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 48 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 8. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
 - 10. 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.

11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 12. In the communications equipment room, install a 10-foot-long service loop on each end of cable. The service loop shall be secured to the wall above the ladder rack.
 13. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. 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 twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 48 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Separation from EMI Sources:
1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper 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 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 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 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways, 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 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Light Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."

- C. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

- A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground as indicated on the drawings using a minimum No. 4 AWG grounding electrode conductor.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B.
 - 1. Administration Class: Class 1.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Cable Schedule: Install in a prominent location the telecommunications room. List incoming and outgoing cables and their designations, origins, and destinations. Protect with clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- D. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within patch panel.
 - 3. Label each terminal in each rack or patch panel.
 - 4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- E. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

- #### B. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

C. Nonconforming Work:

1. End-to-end cabling will be considered defective if it does not pass tests and inspections.
2. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

- #### D. Collect, assemble, and submit test and inspection reports.

E. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION 271513

SECTION 275123.50 - EDUCATIONAL INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of this Section includes providing additional devices to the existing IP-based intercommunications and program system.
- B. Related Requirements:
 - 1. Section 271513 "Communications Copper Horizontal Cabling" for balanced twisted-pair cabling used for voice and data circuits.

1.2 DEFINITIONS

- A. H.323: Audio and Video Protocol.
- B. SIP: Session Initiation Protocol.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Speaker-microphone stations.
 - 2. Cone-type loudspeakers/speaker microphones.
- B. Shop Drawings: For educational intercommunications and program systems.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include scaled drawings for administrative console and speaker-microphone station arrangement of built-in equipment.
 - 4. Include diagrams for power, signal, and control wiring.
 - a. Identify terminals to facilitate installation, operation, and maintenance.
 - b. Single-line diagram showing interconnection of components.
 - c. Cabling diagram showing cable routing.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) elevations, drawn to scale, and coordinated with each other, using input from installers of the items involved.

- B. Qualification Data: For Installer.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On USB media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 EDUCATIONAL INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Advanced Network Devices.

2.2 SYSTEM OPERATION

- A. The system shall provide all open speaker communications for public address, intercom, emergency call, tone scheduling and emergency notification operations. Additionally, the system shall interconnect and interoperate with other emergency systems and synchronize time display as shown on project drawings.
- B. All devices shall be LAN/WAN connected, software programmable, PoE compliant (no incremental midspan devices required), and utilize standard network protocols.

2.3 IP SPEAKER WITH LED DISPLAY

- A. Model Number: IPSWD-RWG to match the existing devices.
 - 1. Provide complete with backbox and all necessary installation components.
 - 2. PoE compliant.
- B. Network Switch: Owner provided.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for installation of conduits and wireways.
- C. Install materials and equipment in accordance with applicable standards, codes, requirements, and recommendations of national, state, and local authorities having jurisdiction, and National Electrical Code® (NEC) 2005 and with manufacturer's printed instructions.
- D. Adhere to manufacturer's published specifications for pulling tension, minimum bend radii, and sidewall pressure when installing cables.

3.2 INSTALLATION OF GROUNDING

- A. Grounding shall conform to ANSI-J-STD607(A) - Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code, ANSI/NECA/BICSI-568- 2006 and manufacturer's grounding requirements as minimum.

3.3 LABELING

- A. Labeling shall conform to ANSI/TIA/EIA-606(A) standards. In addition, provide the following:
 - 1. Label each outlet with permanent self-adhesive label with minimum 3/16 in. high characters.
 - 2. Label each cable with permanent self-adhesive label with minimum, 1/8 in. high characters, in the following locations:
 - a. Inside receptacle box at the work area.
 - b. Behind the communication closet patch panel or punch block. Mount termination blocks on color-coded backboards.
 - 3. Labels shall be machine-printed. Hand-lettered labels shall not be acceptable.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative:
- B. Tests and Inspections:
 - 1. Schedule tests with at least seven days' advance notice of test performance.
 - 2. After installing educational intercommunications and program systems and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: Test originating station-to-station, all-call, and page messages at each intercommunication station. Verify proper routing and volume levels and that system is

free of noise and distortion. Test each available message path from each station on the system.

- C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging and independent room speaker-line matching transformers.
- D. Educational intercommunications and program systems will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
- B. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 275123.50

SECTION 275130 - CLASSROOM TECHNOLOGY SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 RELATED SECTIONS

- A. Section 01 - GENERAL REQUIREMENTS.
- B. Section 260030 - Administrative Requirements.
- C. Section 270010 – Supplemental Requirements for Communications.
- D. Section 270528 – Pathways for Communication Systems.

1.3 DESCRIPTION OF WORK:

- A. Provide a combined educational presentation system, consisting of a classroom sound amplification system (CSAS) and document camera with all necessary materials and labor to fulfill the requirements and the intent of the specifications. Each system is a complete distinct and individual system as specified herein.
- B. Equipment shall be furnished and installed as specified. No substitutions will be allowed.
- C. All electronic equipment shall be new and of current model. Systems shall be guaranteed for a period of one (5) years from the date of completion against defective materials, inferior workmanship or improper installation adjustment. Guarantee shall cover all parts and labor.
- D. The contractor shall furnish the owner with complete electronic service and operating literature.
- E. All equipment shall be installed by a communications contractor with at least five (5) years experience installing similar systems. The contractor shall be the factory authorized distributor for the geographical area and shall maintain complete installation and service facilities.
- F. All work shall be done by expert technicians qualified in the field with knowledge of systems and detailed requirements for fine tuned performance. Workmanship shall comply with standard professional roadcast practice concerning grounding, shielding, cable dressing, cable termination and equipment mounting. All mounting holes shall be utilized for any equipment.
- G. Systems shall function without audible distortion, hum, buzz or rattle under normal operating conditions. Equipment shall be installed plumb and square.

- H. Cables shall be marked with commercial wire markers and shall be designated with the architectural room number or description of the area served by that circuit.
- I. All equipment shall be installed as shown on the drawings and in strict accordance with the specifications. Any errors, conflicts, or omissions discovered in the specifications or the drawings shall be submitted in writing to the engineer for clarification. Installation shall not proceed until questions have been resolved.

1.4 QUALIFICATIONS:

- A. The contractor must bid on the equipment specified in this document. No substitutions of any component or system will be considered. The manufacturer's name, model numbers shall be included in the shop/working drawings complete with catalog sheets, technical and installation data shall be submitted for approval.

1.5 SUBMITTALS:

A. PRODUCT DATA:

- 1. Submit manufacturer's data sheet including specifications, installation instructions, and general recommendations for each piece of equipment specified.

B. SHOP DRAWINGS:

- 1. Submit dimensioned drawings and wiring layout for any changes in wiring from the layout in the drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. PlenumVault® Direct View Systems shall be a complete AV systems for classrooms that have flat panel displays. They deliver an excellent experience for students and instructors, providing enhanced audio and video quality for in-person, hybrid, and remote learning environments. Various AV control interface, AV signal extension, speakers, mounting hardware, and cable options are available to create a customized classroom AV solution. Advanced audio capabilities include integrated amplifier, audio input mixing, and line level outputs for remote learning or assistive listening. Add a VoiceLift® Pro Microphone so students hear the instructor clearly throughout the room. Integration with GlobalViewer® Campus Communication Suite adds bells, public address announcements, and intercom communications over the network.
 - 1. Software and control options
 - a. Configuration Software Extron Global Configurator® Plus and Professional for Windows®
 - b. Control Apps Extron Control

- c. Utilities Toolbelt
 - d. Hardware user interfaces TouchLink® Pro touchpanels, Network Button Panels, eBUS Button Panels
2. Audio System
- a. Volume control range -100 dB to 0 dB (control 0 to 100 in 1 dB steps)
 - b. Crosstalk <-85 dB @ 1 kHz
 - c. Stereo channel separation >80 dB @ 1 kHz
3. Audio input VoiceLift receiver
- a. Number/signal type 1 mono, balanced (mic)
 - b. Connectors 1 female RJ-45
 - c. Impedance >10k ohms unbalanced/balanced, DC coupled
 - d. Nominal level -10 dBV (316 mVrms)
 - e. Input gain/volume adjustment -18 dB to +24 dB (default = 0 dB), adjustable independently from all other audio gain and volume controls via PCS
4. Audio input – Line
- a. Number/signal type 1 stereo, unbalanced or balanced
 - b. Connectors 1 female 3.5 mm captive screw connector, 5 pole
 - c. Impedance >10k ohms unbalanced/balanced, DC coupled
 - d. Nominal level -10 dBV (316 mVrms)
 - e. Input gain/volume adjustment -18 dB to +24 dB (default = 0 dB), adjustable independently from all other audio gain and volume controls via PCS
5. Audio input – Aux
- a. Number/signal type 1 mono, unbalanced or balanced
 - b. Connectors 1 female 3.5 mm captive screw connector, 3 pole
 - c. Impedance >10k ohms unbalanced/balanced, DC coupled
 - d. Nominal level -10 dBV (316 mVrms)
 - e. Input gain/volume adjustment -18 dB to +24 dB (default = 0 dB), adjustable independently from all other audio gain and volume controls via PCS
6. Audio input – Digital
- a. Number/signal type 1 S/PDIF (optical)
 - b. Connectors 1 female TOSLINK fiber optic connector
 - c. Source formats PCM 32 kHz, 44.1 kHz, 48 kHz, 96 kHz and 192 kHz sample rates, up to 24-bit.
 - d. Listening modes Stereo
 - e. Input gain/volume adjustment -18 dB to +12 dB (default = 0 dB), adjustable independently from all other audio gain and volume controls via PCS

7. Audio output – line level
 - a. Number/signal type 1 stereo/mono, balanced/unbalanced, fixed/variable
 - b. Connector (1) 3.5 mm captive screw connector, 5 pole
 - c. Impedance 50 ohms unbalanced, 100 ohms balanced
 - d. Gain error ± 0.8 dB channel to channel
 - e. Maximum level +15 dBu, balanced, at $<0.1\%$ THD+N
8. Audio output – power amplifier
 - a. Number/signal type 1 stereo/mono, balanced/unbalanced, fixed/variable
 - b. Connector (1) 5.0 mm captive screw connector, 4 pole
 - c. Load impedance 4/8 ohms, single channel or stereo
 - d. Amplifier type Class D
 - e. Frequency response 20 Hz to 20 kHz, +1 dB/-3dB @ 1 watt output, 8 ohm load
 - f. THD + Noise 0.1%, 1 kHz, 3 dB below clipping
 - g. S/N >90 dB, 20 Hz to 20 kHz at maximum output (unweighted), 8 ohms
 - h. Output power 25 watts per channel, 4/8 ohms, 1kHz, 1% THD
 - i. Damping factor >75 @ 8 ohm
9. Communication – configuration port
 - a. USB control port 1 front panel female USB type-C
 - b. USB standard USB 2.0, high speed
 - c. Paging sensor connector (1) 3.5 mm captive screw connector, 3 pole
10. Serial control
 - a. Quantity/type 1 bidirectional RS-232
 - b. Connector (1) 3.5 mm direct insertion captive screw connector, 3 pole
 - c. Baud rate and protocol 300 to 115200 baud (9600 baud = default); 8 data bits; 1 (default) or 2 stop bits; no parity (default), even, or odd parity
 - d. Pin configurations
 - 1) Serial, 3 pole captive screw
 - 2) RS-232 (default) Pin 1 = Tx, 2 = Rx, 3 = Gnd
11. IR/serial control
 - a. Quantity/type 1 programmable: unidirectional RS-232 (± 5 V), or TTL level (0 to 5 V) infrared (carrier and non-carrier) up to 300 kHz
 - b. Connector (1) 3.5 mm direct insertion captive screw connector, 2-pole
 - c. Baud rate and protocol

- 1) (RS-232) 300 to 115200 baud (9600 baud = default); 8 data bits; 1 (default) or 2 stop bits; no parity (default), even, odd, mark, or space parity
- 2) Pin configurations For each port, pin 1 = signal, 2 = Gnd
- 3) IR output carrier frequency 30 kHz to 300 kHz

12. Digital input/outputs

- a. Quantity/type 2 digital inputs (configurable) referenced to ground
- b. Connector (1) 3.5 mm captive screw connector, 3 pole
- c. Digital inputs
 - 1) Input voltage range 0 to 24 VDC, clamped at +30 VDC
 - 2) Input impedance >10k ohms
 - 3) Programmable pullup 1k ohms to +5 VDC
 - 4) Threshold low to high >2.8 VDC
 - 5) Threshold high to low <2.0 VDC
- d. Digital outputs 250 mA sink from 24 VDC max.

13. eBUS control

- a. eBUS control ports (1) 3.5 mm captive screw connector, 4 pole
- b. eBUS pin configuration +V = +12 VDC; +S = + signal; -S = - signal; G = ground
- c. Recommended cable type Extron STP20-2/1000 or STP20-2P/1000 cable
- d. Maximum system cable length 1000 feet (305 meters) sum total for the eBUS system, regardless of topology.
- e. Power injection may be required depending on system cabling topology and primary power supply wattage. See the PVCA 452 User Guide for details.
- f. eBUS power output 3 watts

14. Ethernet control

- a. Network interface controllers
 - 1) (NICs) 1
 - 2) Connector 1 female RJ-45 connector
 - 3) Data rate 10/100/1000Base-T, half/full duplex with autodetect
 - 4) Protocols DHCP, DNS, HTTP, HTTPS, ICMP, NTP, SFTP, SMTP, SNMP, SSH, TCP/IP, UDP/IP
- b. Default settings Link speed and duplex level = autodetected
 - 1) IP address = 192.168.254.250
 - 2) Subnet mask = 255.255.255.0
 - 3) Gateway = 0.0.0.0
 - 4) DHCP = off

5) DNS: 127.0.0.1

15. General

- a. Power supply External
- b. Power input requirements
 - 1) Input: 100-240 VAC, 50-60 Hz
 - 2) Output: 12 VDC, 4.2 A, 50 watts
- c. Power consumption
 - 1) Device 18.16 watts
 - 2) Device and power supply 20.55 watts
- d. Temperature/humidity
 - 1) Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
 - 2) Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing
- e. Cooling Convection, no vents
- f. Thermal dissipation
 - 1) Device 18.86 BTU/hr
 - 2) Device and power supply 27.01 BTU/hr
- g. Mounting
 - 1) Rack mount Yes, with optional 1U rack shelf
 - 2) Furniture or wall mount Yes, with optional under-desk mounting kit
- h. Enclosure type Metal
- i. Enclosure dimensions 1.00" H x 13.1" W x 3.5" D (2.5 cm H x 33.3 cm W x 8.9 cm D) (Depth excludes connectors)
- j. Product weight 1.20 lbs (0.5 kg)
- k. Vibration ISTA 1A in carton (International Safe Transit Association)
- l. Regulatory compliance
 - 1) Safety CE, c-UL, UL
 - a) UL Listed for use in plenum air handling spaces: meets UL 2043 for heat and smoke release
 - 2) EMI/EMC CE, C-tick, FCC Class A, ICES, VCCI Class A
 - a) Complies with the appropriate requirements of RoHS, WEEE
- m. Warranty 3 years parts and labor

16. WPD 110 A Wallplate

- a. Frame rate1 24, 25, 30, 50, or 60 fps
- b. Chroma sampling1 4:4:4, 4:2:2, or 4:2:0
- c. Color bit depth1 8 bits per color
- d. Signal type1 HDMI 1.4
- e. Max. video data rate
 - 1) HDMI 10.2 Gbps (3.4 Gbps per color)
- f. Mounting Extron AAP 314, AAP 424, or US-gang decorator-style mounting frames
 - 1) Furniture or wall mount Yes, with standard decorator-style wallplate
- g. Enclosure type Plastic
- h. Connector type HDMI female to HDMI female
- i. 3.5 mm stereo audio jack to captive screw 3.5 mm Captive screw connector, 3-pole to 3.5 mm captive screw connector, 3-pole
- j. Cable dimensions
 - 1) Cable length 12.75" (324 mm)
 - 2) Cable outer diameter 0.24" (6.0 mm)
- k. Enclosure dimensions
 - 1) Module 4.10" H x 1.60" W x 0.26" D (104 mm H x 41 mm W x 6.6 mm D) (Depth excludes connectors. Fits into standard one-gang decorator-style frame.)
 - 2) Mounting holes are 3.80" (97 mm) apart.
 - 3) Face is 2.61" H x 1.29" W (66 mm H x 33 mm W).
 - 4) Product weight 0.1 lb (<0.1 kg)
 - 5) Regulatory compliance RoHS, WEEE

17. EBP 100

- a. eBUS control interface
 - 1) eBUS control ports (2) 3.5 mm captive screw connectors, 4 pole
 - 2) eBUS pin configuration +V = +12 VDC; +S = + signal; -S = - signal; G = ground
 - 3) Recommended cable type Extron STP20-2/1000 or STP20-2P/1000 cable
 - 4) Maximum system cable length 1000 feet (305 meters) sum total for the eBUS system, regardless of topology. Power injection may be required depending on system cabling topology and primary power supply wattage. See the EBP 100 and EBP 200 Setup Guide or eBUS Technology Reference Guide for details.

b. Software and control options

- 1) Configuration software Global Configurator Plus and Professional
- 2) Control apps Extron Control
- 3) Utilities Toolbelt

c. General

- 1) Power 12 VDC (Power is supplied by an Extron IPCP Pro series control processor or optional power supply).
- 2) Power consumption 0.5 W
- 3) Temperature/humidity Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing
- 4) Enclosure type Plastic faceplate and high-impact plastic rear enclosure
- 5) Enclosure dimensions
 - a) Faceplate 4.5" H x 4.6" W x 0.3" D (11.4 cm H x 11.7 cm W x 0.8 cm D)
 - b) Device 2.7" H* x 3.5" W x 0.8" D (6.9 cm H* x 8.9 cm W x 2.1 cm D) 2.7" H* x 3.5" W x 1.25" D (6.9 cm H* x 8.9 cm W x 3.2 cm D) including captive screw connectors (Depth excludes faceplate and buttons. Fits most 2 gang US boxes or mud rings. Allow at least 1.9" [4.7 cm] depth in the wall or furniture.)
- 6) Product weight 0.5 lb (0.2 kg)
- 7) Regulatory compliance
 - a) Safety CE, c-UL, UL
 - b) EMI/EMC CE, C-Tick, FCC Class A, ICES, VCCI class A. Complies with the appropriate requirements of RoHS, WEEE
 - c) Accessibility Complies with the appropriate requirements of Section 508 of the Rehabilitation Act (29 U.S.C. 794d).

18. FF 120 Flat Field® Speakers

- a. Power capacity
 - 1) 16 W (rms) continuous pink noise
 - 2) 32 W (rms) continuous program
- b. Nominal coverage angle 170° conical coverage
- c. Nominal impedance 8 ohms per speaker
- d. Mounting Drops into a 2' x 2' (610 mm x 610 mm) or 2' x 4' (610 mm x 1220 mm) suspended tile
- e. Enclosure outer dimensions 3.25" H x 23.75" W x 11.75" D

- f. Product weight Single: 4.7 lbs (2.1 kg)
- g. Regulatory compliance
 - 1) CE, NFPA90A, NFPA70;
 - 2) UL listed for use in plenum airspaces: meets UL 2043 for heat and smoke release; meets UL 1480 - speakers for commercial and professional use.

19. PVM 220

- a. Mounting Drop ceiling mountable (installs on drop ceiling within air-handling space)
- b. Maximum load capacity 15 lbs (6.8 kg) on door
- c. Enclosure material Composite
- d. Door frame and mounting plate Aluminum
- e. Dimensions 6.3" H x 23.8" W x 23.8" D
- f. Product weight 16.0 lbs (7.3 kg)
- g. Regulatory compliance
 - 1) CE, c-UL, UL as an accessory for use with a UL listed mount and projector.
 - 2) UL listed for use in plenum airspaces: meets UL 2043 for heat and smoke release.
 - 3) OSHPD anchorage pre-approval.

2.2 OVERHEAD DOCUMENT CAMERA

A. Manufacturer: Vaddio.

- B. Description: DocCAM 20 HDBT Ceiling-Mounted Camera is a high-definition, recessed in-ceiling document camera with a 1/2.8" Exmor CMOS sensor, a 20x optical zoom, full HD 1080p/60 fps resolution, and a 59.5° horizontal field of view. The DocCAM 20 HDBT features OneLINK/HDBaseT PoE+ connector. The camera can be controlled via the included IR remote control and has no physical switches. Hardware configuration is done via the web interface. The DocCAM is suitable for video conference calls, training sessions, and online learning courses. It can also be used with the OneLink Bridge AV interface (sold separately) to provide camera power, control and video from the camera to other devices, or it can be powered by any PoE+ third-party devices.

- 1. Exmor 1/2.8 type, high-speed, low-noise image sensor for 2.38 megapixels total, full HD (native 1080p/60).
- 2. 20x optical zoom with horizontal field of view from 60° (wide end) to 3.3° (tele end)
- 3. Low-power laser pointer for centering.
- 4. Superior low-light performance (0.4 lux).
- 5. Web interface for remote administration and operation, integration-ready Telnet and serial RS-232 control, presenter friendly IR remote control.
- 6. Use with a OneLINK HDMI and Bridge devices for power, video, and control.

C. Vaddio OneLINK Bridge Express

1. Connect PTZ camera and analog audio source to a streaming application with the OneLINK Bridge Express from Vaddio. The bridge makes it easy to input PTZ camera video via HDBaseT and output up to 1080p60 video to a USB Type-B port. It can also output video via an HDMI port for monitoring. It also features audio mic/line input and output terminal blocks to input and output balanced analog audio.
2. The bridge can be used for video conferencing and IP meeting applications in an easy-to-use package. The bridge is powered using its included power adapter and it can input and deliver video over Cat 6 cable over 328' away. It can be controlled via RS-232, telnet, or IP.

D. Key Features:

1. Simple, clutter-free camera extension with HDBaseT technology.
2. Power, video, and control over a single Cat 5e cable up to 230' or over a Cat 6 cable up to 328'.
3. Configurable audio matrix with AEC.
4. Simultaneous HDMI, USB 3.0, and IP streaming outputs.
5. Up to 1080p60 resolution available over uncompressed USB.
6. Status lights.

PART 3 - EXECUTION

3.1 INSTALLATION OF SOUND SYSTEMS:

- A. Install each system shown as indicated, in accordance with equipment manufacturer's instructions, and with recognized industry practices, to ensure that system equipment complies with requirements. Comply with requirements of NEC and applicable portions of NECA's "Standard of Installation" practices.
- B. Provide each individual CSAS with a receiver/amplifier, teacher microphone with transmitter, hand held microphone, external sensors as required, speakers as required (minimum 4) and all cable necessary. Before rough-in, test each application for the number and location of sensors and speakers required. Install sensors as required for complete coverage in all parts of the space. Coordinate the number of speakers required with the reflected ceiling needs. Provide a back box for each speaker and verify all support requirements. Provide audio wiring from the receiver/amplifier to the video system controller in the room.
- C. Coordinate with other electrical work, including cable/wire, raceways, electrical boxes and fittings, as appropriate to interface installation with other systems work.
- D. Provide each video system with all equipment specified and cables shown for a complete system.

3.2 EQUIPMENT CHECKOUT:

- A. Provide equipment checkout by a factory trained and authorized technician before energizing circuits. Make final connections under his direction.

3.3 TESTING:

- A. Upon completion of installation of the, system and after electrical circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed retesting.

3.4 WARRANTY:

- A. The contractor shall warrant the equipment to be new and free from defects in material and workmanship, and will, within one year from date of installation, repair or replace any equipment found to be defective. This warranty shall not apply to any equipment which has been subject to misuse, abuse, negligence, accident or unauthorized modification.

3.5 TRAINING:

- A. Provide a minimum of 2 each 1 hour training sessions on separate days that are acceptable to the owner. Training shall include the operation and maintenance of the audio/visual presentation system, at job site. Provide in-depth training as required to allow the district to do any adjustments that the supplier is allowed to do during commissioning, testing, service and field additions or deletions to the system. Provide this training at no cost to the Owner, including transportation, lodging, meals and training manuals.

END OF SECTION 275130

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Voice evac control unit.
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Nonsystem smoke detectors.
6. Heat detectors.
7. Notification appliances.
8. Magnetic door holders.
9. Remote annunciator.
10. Addressable interface device.
11. Digital alarm communicator transmitter.
12. Fire Fighter paging microphone.

B. Applicable Codes and Standard include, but are not limited to:

1. International Building Code (IBC) – Latest adopted edition.
2. International Fire Code (IFC) – Latest adopted edition.
3. National Fire Protection Association (NFPA) 70 – National Electrical Code – Latest edition.
4. National Fire Protection Association (NFPA) 72 – National Fire Alarm Code – Latest edition.

C. Manual fire alarm boxes shall be provided as shown on the drawings at all exits subject to approval by AHJ.

D. Provide automatic detection in all hallways, stairs, cafeterias, shop areas, etc. and as shown. Automatic detection is not required in closets, vestibules, etc.

E. System shall be capable of use as an Emergency Communications System per NFPA 72 Chapter 24.

F. System shall be capable of receiving emergency voice announcements from a remote location. Remote location has not been determined and remote equipment is not included in this project.

G. System shall interface with Educational Intercommunications and Program System and the Auditorium Sound System so that the fire alarm/emergency communications system will override the intercom/paging system during an emergency.

- H. Provide carbon monoxide detectors for areas with fuel burning appliances in accordance with 2015 International Fire Code or as required by AHJ.

1.2 DELEGATED DESIGN

- A. The entire system described in this section shall be designed by the Contractor. See Part 1.5D below.
- B. Devices shown on the drawings provide the basic layout, coverage and notification areas. The Contractor is responsible for a complete design and construction of a complete and operable system that meets or exceeds the requirements of this section, related sections and the AHJ.

1.3 SCOPE

- A. Expansion of the existing Simplex voice and visual notification. Provide new devices required for a complete system include expansion panels, power supplies with battery backup as required for the building expansion. Provide a smoke detector at each panel location.
- B. Provide automatic detection only where required and where shown on the drawings by applicable codes and standards.
- C. Provide interface and monitoring of all fire suppression and other building systems as required by all applicable codes and standards.

1.4 FIELD INVESTIGATION

- A. Contractor shall be responsible for detailed knowledge of all existing conditions that affect their work prior to bid.
- B. Contractor shall conduct thorough field investigations of existing conditions at the building such that they understand all conditions that affect the work described in this section and related sections. These items include, but are not limited to the following:
 - 1. Location, type and functional details of all existing system components.
 - 2. Location, type, routing, and installation details of all cabling.
 - 3. Work required to remove and replace existing devices if necessary.
 - 4. Work required to patch existing building finishes.
 - 5. Work required to install all new components including modifying existing finishes.

1.5 ACTION SUBMITTALS

- A. General Submittal Requirements:
 - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 - a. Contractor is responsible for all review submission requirements and fees.

2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; Level IV minimum or Professional Engineer licensed for Fire Alarm Systems in the State of Wyoming.
 - c. See Part D below for designer qualifications.
- B. Product Data: For each type of product, including furnished options, accessories, backbox and mounting requirements.
- C. Shop Drawings: For fire-alarm system.
 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 2. Include plans, elevations, sections, details, and attachments to other work.
 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 4. Detail assembly and support requirements.
 5. Include voltage drop calculations for notification-appliance circuits.
 6. Include battery-size calculations.
 7. Include input/output matrix.
 8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
 9. Include performance parameters and installation details for each detector.
 10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring required for HVAC unit shutdown on alarm.
 - c. Locate detectors according to manufacturer's written recommendations.
 12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified NICET as fire alarm Level IV or licensed professional engineer responsible for their preparation.
 1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
 2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels and/or intelligibility for audible appliances.

E. Additional power supplies and power connections:

1. Provide additional control equipment, power supplies and power connections as required to support all equipment and devices. Show any additional equipment in shop drawings.
2. Provide all required 120 Volt power connections.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Data: Certificates, for fire-alarm control unit, accessories, and components, from manufacturer.
- C. Field quality-control reports.
- D. Sample warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment.
 - d. Riser diagram.
 - e. Record copy of site-specific software.
 - f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - g. Manufacturer's required maintenance related to system warranty requirements.
 - h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.
- B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician and Level I audio technician.
- C. System provider shall be capable of providing emergency service response at the project site within 2 hours of any call for service. Service technician shall be available 24 hour/day 365 days/year.
- D. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: All components shall be manufactured by a single manufacturer or shall be certified to operate as part of a complete system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice-and-strobe notification for evacuation.
- C. Automatic sensitivity control of certain smoke detectors.
- D. All components provided shall be listed for use with the selected system.
- E. 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.

2.2 MANUFACTURERS

- A. The existing Fire Alarm System is Simplex. It shall be acceptable to upgrade the existing fire alarm system and utilize the existing devices that are compatible with the new system. All existing components and wiring with these specifications not in compliance as a result of this expansion shall be removed and replaced at the contractors cost.

2.3 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
1. Manual stations.
 2. Heat detectors.
 3. Smoke detectors.
 4. Duct smoke detectors.
 5. Automatic sprinkler system water flow.
 6. Fire standpipe system.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances including voice evacuation notices.
 2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Release fire and smoke doors held open by magnetic door holders.
 6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 8. Recall elevators to primary or alternate recall floors.
 9. Activate elevator power shunt trip.
 10. Activate emergency lighting control.
 11. Activate emergency shutoffs for gas and fuel supplies.
 12. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. High- or low-air-pressure switch of a dry-pipe or pre-action sprinkler system.
 3. Elevator shunt-trip supervision.
 4. Loss of communication with any panel on the network.
- 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 communication with any addressable sensor, input module, relay, control module, or remote annunciator.
 4. Loss of primary power at fire-alarm control unit.

5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

2.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.5 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 0.

- D. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet located in the fire command location.
1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
 - a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - d. 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 and the status of firefighters' two-way telephone communication zones.
 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- E. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
 2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
 3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- F. Elevator Recall:
1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
 - 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 controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
 3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

- H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
- L. Network Capabilities: Provide provisions for networking with future panels installed in other locations on the campus.

2.6 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.
 - 1. Manual fire alarm boxes shall be installed in administrative areas only. Locations subject to approval by AHJ.
 - 2. Existing manual fire alarm boxes shall be removed.
 - 3. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 4. Station Reset: Key- or wrench-operated switch.

2.7 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be four-wire type.
 - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.

7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
 - b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
 - c. Multiple levels of detection sensitivity for each sensor.
 - d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:

1. 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.
2. 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. 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.
2. 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.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.8 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature or a rate of rise.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.9 CARBON MONOXIDE DETECTORS

- A. General: Carbon monoxide detector listed for connection to fire-alarm system.
 1. Mounting: Adapter plate for outlet box mounting.
 2. Testable by introducing test carbon monoxide into the sensing cell.
 3. Detector shall provide alarm contacts and trouble contacts.
 4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
 5. Comply with UL 2075.
 6. Locate, mount, and wire according to manufacturer's written instructions.
 7. Provide means for addressable connection to fire-alarm system.
 8. Test button simulates an alarm condition.

2.10 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Voice/Tone Notification Appliances:
 1. Comply with UL 1480.
 2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
 3. High-Range Units: Rated 2 to 15 W.
 4. Low-Range Units: Rated 1 to 2 W.
 5. Mounting: Flush.
 6. Matching Transformers: Tap range matched to acoustical environment of speaker location.
- C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Allowed for exterior notification appliances only.

- D. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
1. Mounting: Wall mounted unless otherwise indicated.
 2. Flashing shall be in a temporal pattern, synchronized with other units.
 3. Strobe Leads: Factory connected to screw terminals.
 4. Mounting Faceplate: Factory finished, white.

2.11 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
1. Electromagnets: Require no more than 3 W to develop 25-lbf holding force.
 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
 3. Rating: 24-V ac or dc.
 4. Rating: 120-V ac.
- B. Material and Finish: Match door hardware.

2.12 REMOTE ANNUNCIATOR

- 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. Mounting: Flush cabinet, NEMA 250, Type 1.
- 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.
- C. Fire Fighter Paging Microphone: Paging microphone for paging throughout the facility.
1. Selective-talk type for use by firefighters and other authorized personnel.
 2. Handset: Push-to-talk with noise-canceling microphone stored in cabinet adjacent to Fire Alarm Remote Annunciator.

2.13 ADDRESSABLE INTERFACE DEVICE

- A. General:
1. Include address-setting means on the module.
 2. Store an internal identifying code for control panel use to identify the module type.
 3. Listed for controlling HVAC fan motor controllers.

- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.
 - 1. Allow the control panel to switch the relay contacts on command.
 - 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
 - 1. Operate notification devices.
 - 2. Operate solenoids for use in sprinkler service.

2.14 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 transmit signals via the communications network using a cellular (GSM) communicator. The system shall also automatically capture one telephone line 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.

2.15 FIREFIGHTERS' COMMUNICATION SERVICE

- A. Dedicated, communication links between fire-alarm control unit and remote firefighters' stations for firefighter control of voice evacuation system. Provide the following:
 - 1. Common-talk type for firefighter use only.
 - 2. Selective-talk type for use by firefighters and fire wardens.
 - 3. Addressable firefighters' phone modules to monitor and control a loop of firefighter phones. Module shall be capable of differentiating between normal, off-hook, and trouble conditions.
 - 4. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is taken off the hook, it causes an audible signal to sound and a high-intensity lamp to flash at the fire-alarm control unit.
 - 5. Display: Digital.
 - 6. Remote Cabinet: Flush mounted cabinet as indicated, factory-standard red finish, with handset.
 - a. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Emergency Phone."
 - 7. Handsets: One set stored in the cabinet

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
- C. Equipment Mounting: Install fire-alarm control unit on finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."
- D. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."

E. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

F. Smoke- or Heat-Detector Spacing: Comply with NFPA 72.

G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

I. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

J. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

K. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

M. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 WIRING METHODS

A. Wiring may be run in free air where concealed above accessible ceilings.

B. Wiring shall be installed in EMT raceway where installed in walls or any other inaccessible area such as a GWB ceilings.

C. Wiring shall be installed in EMT raceway where wiring is exposed in areas such as a mechanical rooms, etc.

D. Exposed EMT shall be painted red enamel.

E. Provide plenum rated cable where installed in air plenums or install wiring in raceway.

3.3 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated HVAC duct systems.
 - 2. Magnetically held-open doors.
 - 3. Electronically locked doors and access gates.
 - 4. Alarm-initiating connection to elevator recall system and components.
 - 5. Alarm-initiating connection to activate emergency lighting control.
 - 6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 7. Supervisory connections at valve supervisory switches.
 - 8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - 9. Supervisory connections at elevator shunt-trip breaker.
 - 10. Supervisory connections at fire-extinguisher locations.

3.4 IDENTIFICATION

- A. Install framed instructions in a location visible from fire-alarm control unit.

3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.6 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Perform the following tests and inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter.

- b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.7 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.
- B. Provide 2 hours of training at a time acceptable to the owner.

END OF SECTION 284621.11