

DEPARTMENT OF PURCHASING

90 Delaware Avenue, 4th floor, Paterson, NJ 07503 Telephone: (973) 321-0726

Website: www.paterson.k12.nj.us





INVITATION TO BID

2024-2025 SCHOOL YEAR

Bid Title:	BATHROOM RENOVATIONS AT EASTSIDE HIGH SCHOOL
Bid Number:	PPS-298-25
Non-Mandatory Pre-Bid Meeting Date, Place & Time:	Tuesday, May 13, 2025 Eastside High School 150 Park Avenue Paterson, New Jersey 10:00 AM
Bid Opening/Due Date & Time:	Wednesday, May 28, 2025, at 10:00 AM
Bid Opening Place:	LIVESTREAM – ZOOM-PASSWORD 5050



ISSUE DATE: 5/9/2025

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ETHICS AND CONDUCT

POLICY RELEASE

The Paterson Public School District will comply with the New Jersey Public School Contracts Law, *N.J.S.A.* 18A:18A-1, *et seq.* The District shall not knowingly extend favoritism to any contractor. Orders shall be placed based on quality, price and timely service. The District shall not solicit funds or materials from contractors. Employees shall not seek to procure goods and services for their own use using District's discounts or tax-exempt status. No purchases will be made knowingly from a District employee or from a member of the immediate household of an employee.

The Department of Purchasing believes in the dignity of their office, the real worth of the service rendered by their governmental agency and strives to maintain high standards of ethics, conduct and service.

Public purchasing employees are required to maintain complete independence and impartiality in dealings with contractors, both in fact and in appearance, to preserve the integrity of the competitive process and to ensure there is public confidence that contracts are awarded equitably economically and in full compliance with Public School Contracts Law.

To avoid any misunderstanding regarding compliance with the law and regarding any appearance of impropriety relative to the competitive process of awarding contracts, purchasing staff shall not accept anything of value offered from contractors.

SOLICITATION OR ACCEPTANCE OF GIFTS

In accordance with the School Ethics Act, N.J.S.A. 18A:12-21, et seq, no school district employee shall solicit, receive or agree to receive any compensation, reward, employment, gift, meal, honorarium, travel, reimbursement, or any other thing of value from any person, firm, corporation, association, partnership or business that is the recipient of, or a potential Bidder or, or applicant for any contract, professional services contract, or purchase order from the school district.

Any school district employee who violates the terms of the School Ethics Act will be subject to consequences which may include, but are not limited to, suspension, termination of employment, withholding of annual increments or demotion.

DOING BUSINESS WITH ONE'S AGENCY

No employee of the District shall either directly or indirectly purchase goods and/or services for his own agency from any business entity of which their spouse or relative has a material interest.

UNAUTHORIZED COMPENSATION

No employee of the District shall, at any time, accept any compensation, payment or thing of value when such employee knows, or with the exercise of reasonable care, should know that the compensation, payment or thing of value it was given to influence a vote or other action in which the officer or employee was expected to participate in his/her official capacity.

RELATIONS WITH CONTRACTORS

The Board of Education shall maintain honest and ethical relations with contractors and shall guard against favoritism, improvidence, extravagance, and corruption in its contracting processes and practices.

The Board will not vote upon or award any contract in the amount of \$17,500 or greater to any business entity which has made a contribution reportable by the recipient under P.L. 1973, c. 83 (codified at *N.J.S.A.* 19:44A-1, *et seq.*) to a member of the Board of Education during the preceding one-year period.

Contributions reportable by the recipient under P.L. 1973, c. 83 (codified at *N.J.S.A.* 19:44A-1, *et seq.*) to any member of the school Board from any business entity doing business with the school district are prohibited during the term of a contract. The Commissioner shall take appropriate action for any violations.

When a business entity is a natural person, a contribution by that person's spouse or child that resides therewith, shall be deemed to be a contribution by the business entity. Where a business entity is other than a natural person, a contribution by any person or other business entity having an interest therein shall be deemed to be a contribution by the business entity.

The disclosure requirement set forth in section 2 of P.L. 2005, c. 271 (codified at *N.J.S.A.* 19:44A-20.26) also shall apply when the contract is required by law to be publicly advertised for bids.

This subsection shall not apply to a contract when a school district emergency requires the immediate delivery of goods or services and shall not apply to contributions made prior to the effective date of these regulations.

Legal Reference: N.J.S.A. 19:44A-1, et seq.; N.J.A.C. 6A:23A-6.3

TO: All Bidders

FROM: Lance Gaines, QPA, Director of Purchasing

RE: New Jersey Sales Tax

Local school districts, as political subdivisions of the State of New Jersey, are exempt from the New Jersey Sales and Use taxes, pursuant to Section 9(a) of the New Jersey Sales and Use Tax Act when purchasing items for their own use such as desks, chairs, office equipment, cleaning supplies, etc.

When purchasing items for the use of a local school district, an exempt organization certificate or number is not required.

When items are purchased for resale through a shop or store regardless of the purpose, the local school district must supply the Contractor with a valid New Jersey Resale Certificate (Form ST-3).

The local school district or any organization under the auspices of the local school district, purchasing items for resale through a shop or a store must be registered with the Division of Taxation as a contractor and have a New Jersey sales tax registration number assigned to them to legally purchase for resale. Sales tax must be collected on the sale of taxable items made in the shop or store.

When purchases for fundraising purposes are made of taxable items by school-affiliated groups, such as band groups, cheerleader groups, school clubs, etc., sales must be paid when making payments on behalf of the group. The subsequent resale of such items by the groups that are conducted for isolated or occasional fund-raising purposes and not through a shop or store are not subject to sales tax.

FEDERAL TAX ID #22600 2199W STATE TAX ID #690220 151

New Jersey school districts are considered political sub-divisions of the State of New Jersey. Therefore, purchases, except purchases of energy, are exempt from NJ sales and use taxes pursuant to Section 9(a)(1) of the New Jersey Sales and Use Tax Act. Click on the following link for a copy of the Technical Bulletin issued by the New Jersey Division of Taxation https://www.state.nj.us/treasury/taxation/pdf/pubs/tb/tb49.pdf

Please note the following:

"ST-5 Exempt Organization Certificates are never issued to New Jersey government entities, including public schools."

PTA/PTO's and Private Nonprofit Schools qualify for exemption upon submitting an application to the Division of Taxation. They are granted an ST-5 Exempt Organization Certificate. Non-Exempt School Groups such as booster clubs, teacher organizations and parent organizations may NOT use a school's tax-exempt status. (see the bulletin for more details).

School Stores operated on a regular basis by a school district or PTA/PTO or other affiliated groups (more frequently than monthly), sales tax must be collected on taxable sales. (see the bulletin for more details).

TO: All Bidders

FROM: Purchasing Department

RE: Unauthorized Purchase Orders

The District only recognizes purchases through the approved purchase order process.

All purchases are made by a written purchase order, with an authorized signature and purchase order number.

Please do not honor or accept any requests for goods and services unless the request is made through a written purchase order with an authorized signature and an assigned purchase order number.

Please alert our office at (973)-321-0726 if any employee attempts to place an order without an authorized purchase order.

Once a purchase order is received do not permit any employee to add items to the order.

The District will not be held responsible for any unauthorized orders or purchases.

The District will only recognize purchase orders signed by the Business Administrator or designee.

TO: All Bidders

FROM: Purchasing Department

RE: Business Registration Certificate

Pursuant to N.J.S.A. 52:32-44, Paterson Public School District is prohibited from entering into a contract with an entity unless the Bidder/proposer/Contractor, and each subcontractor that is required by law to be named in a bid/proposal/contract has a valid Business Registration Certificate on file with the Division of Revenue and Enterprise Services within the Department of the Treasury.

Prior to contract award or authorization, the Contractor shall provide the Contracting Agency with its proof of business registration and that of any named subcontractor(s).

Subcontractors named in a bid or other proposal shall provide proof of business registration to the Bidder, who in turn, shall provide it to the Contracting Agency prior to the time a contract, purchase order, or other contracting document is awarded or authorized.

During contract performance:

- (1) the Contractor shall not enter a contract with a subcontractor unless the subcontractor first provides the contractor with a valid proof of business registration.
- (2) the Contractor shall maintain and submit to the Contracting Agency a list of subcontractors and their addresses that may be updated from time to time.
- (3) the Contractor and any subcontractor providing goods or performing services under the contract, and each of their affiliates, shall collect and remit to the Director of the Division of Taxation in the Department of the Treasury, the use tax due pursuant to the Sales and Use Tax Act, (N.J.S.A. 54:32B-1 et seq.) on all sales of tangible personal property delivered into the State. Any questions in this regard can be directed to the Division of Taxation at (609)292-6400. Form NJ-REG can be filed online at http://www.state.nj.us/treasury/revenue/busregcert.shtml.

Before final payment is made under the contract, the Contractor shall submit to the Contracting Agency a complete and accurate list of all subcontractors used and their addresses.

Pursuant to N.J.S.A. 54:49-4.1, a business organization that fails to provide a copy of a business registration as required, or that provides false business registration information, shall be liable for a penalty of \$25 for each day of violation, not to exceed \$50,000, for each proof of business registration not properly provided under a contract with a contracting agency.

Emergency Purchases or Contracts

For purchases of an emergent nature, the Contractor shall provide its Business Registration Certificate within two weeks from the date of purchase or execution of the contract or prior to payment for goods or services, whichever is earlier.

1. 1. SUBMISSIONS, MODIFICATIONS AND WITHDRAWAL OF BID:

- 1.1 Sealed bids for the work described herein must be received (date & time stamped) by the Paterson Public School District, Department of Purchasing, 90 Delaware Avenue 4th Floor, Paterson, New Jersey 07503, prior to the date and time fixed for bid opening. Bidders are cautioned that reliance on delivery or mail services for timely delivery is at the contractor's risk. Failure on behalf of the Bidder to have his/her sealed bid reach the Department of Purchasing by the prescribed date and time will result in a return of the bid unopened and unread.
- 1.2 The advertising period includes the date for the receipt of the bids, and the bid closing date and time. No bids will be opened prior to the date and time fixed for the bid opening and no bids will be opened after the closing date. Bids will be publicly opened and read aloud on the day and at the time and place specified in the advertisement/invitation to bid.
- **1.3** Bid pricing shall be submitted on the bid proposal form(s) and enclosed in a sealed envelope as provided by the Department of Purchasing. The name and address of the Bidder must be indicated on the envelope as well as the bid number as it appears in the advertisement/invitation to bid.
- **1.4** Under the terms of this invitation to bid, bids shall remain open for acceptance for sixty (60) days and may not be withdrawn after the bid opening. Completion and submission of this bid by Bidders will indicate acceptance of this condition.
- 1.5 A Bidder may modify his or her bid by letter at any time prior to the scheduled closing date and time for the receipt of bids, provided that the communication is received by the Department of Purchasing prior to such closing time. A written confirmation of any modification signed by the Bidder must have been received by the Purchasing Department before the specified closing time for acceptance of bids. The confirmation shall be accompanied by a newly executed affidavit of non-collusion.
- **1.6** Electronic communications shall not reveal the basic bid price
- 1.7 A Bidder may withdraw his or her bid at any time prior to the bid opening only by a written letter of request (on the corporation's letterhead and signed by a corporate officer) to the Department of Purchasing. The right of withdrawal is lost after a bid has been opened. If an error has been made in the bid amount, request for relief may be in writing to the Department of Purchasing. An authorized corporate officer shall sign the written request. A determination of whether the Bidder will be released shall be at the discretion of the Department of Purchasing, which will issue its finding in five (5) working days of receipt of all pertinent information relating to such a request for relief.
- **1.8** If the bid documents or conditions contain some untenable item or extremely expensive provision to which the contractor wishes to raise an objection, this must be done in writing with the purchasing agent no less than three business days prior to the bid opening. Such inquiries will have a response issued by addendum only.
- **1.9** All bid challenges must be in writing pursuant to N.J.S.A. 18A:18A-15.

2. BOND REQUIREMENTS (See Technical Specifications)

2.1 The Bidder shall provide a bid bond or certified check in the amount of 10% of the bid, but not more than \$20,000.00.

3. PERFORMANCE BONDS (N.J.S.A. 18A: 18A-25):

3.1 The successful Bidder shall furnish within ten (10) business days after the notice of the contract award a Performance Bond in statutory form in an amount equal to one hundred percent (100%) of the initial 2-year total contract price as security for faithful performance of this contract. No contract shall be executed unless, and until the required performance bond is submitted to the District's Department of Purchasing, and the Surety must be presently authorized to do business in the State of New Jersey. The cost of all performance bonds required under this contract shall be borne by the successful Bidder. The performance bond must be legally effective as of the date the contract is signed. The bond must indicate the successful Bidder's name exactly as it appears in the contract.

3.2 CERTIFICATE FROM SURETY COMPANY (N.J.S.A. 18A:18A-25)

Each Bidder must submit with his/her proposal a certificate from a surety company stating that the surety company will provide the Bidder with a performance bond in an amount equal to the amount of the contract (N.J.S.A. 18A:18A-25). Such surety company must be licensed and qualified to do business in the State of New Jersey. The certificate (Consent) of Surety, together with the power of attorney, must be submitted with the proposal. Failure to submit the certificate (Consent) of Surety shall be cause for disqualification and rejection of the proposal.

4. CONSIDERATION OF BIDS:

- **4.1** Contracts will be awarded as stated in the Technical Specifications. The board of education shall award the contract or reject all bids within such time as may be specified in the invitation to bid, but in no case more than sixty (60) days, except that the bids of any bidders who consent thereto may, at the request of the board of education, be held for consideration for such longer period as may be agreed.
- **4.2** The bid security of the unsuccessful Contractors (except for the lowest three (3) Contractors) will be returned as follows:
- **4.3** All bid security except the security of the three apparent lowest bidders shall, if requested, be returned after 10 days from the opening of the bids, Sundays and holidays excepted and the bids of such bidders shall be considered as withdrawn. Within three days after the awarding of the contract and the approval if the contractor's performance bond the bid security of the remaining unsuccessful bidders shall be returned to them forthwith, Sundays and holidays excepted.
- **4.4** The District reserves the right to award the contract based on a single bid for the entire work, or based on a separate bid and alternate, or any combination of separate bids and alternates.
- **4.5** The District reserves the right to waive in its sole discretion minor informalities or non-material exceptions where such waiver is permitted by law.
- **4.6** The District reserves the right to reject all bids when such rejection is in accordance with N.J.S.A. 18A:18A-22. The District also may reject the bid of any Contractor who, in its judgment, is not responsible or capable of performing the contract based upon financial capability, past performance, or experience pursuant to applicable law. A Contractor if so, rejected may request a hearing before the Superintendent by filing a written notice.
- **4.7** The contract shall be signed by all parties within the time limit set forth in the specifications, which shall not exceed 21 days, Sundays and holidays excepted, after the making of award. Upon his or her failure or refusal to comply in the manner and the time specified above, the District may either award the contract to the next lowest Contractor or readvertise for new bids. In either case, the District may hold the defaulting Contractor and his or her surety liable for the entire surety amount.

5. AWARDS: (See Technical Specifications)

- **5.1** In executing the contract, the successful Contractor agrees to perform all work in accordance with the terms and conditions of the specifications and to complete all work within the number of calendar days specified in the contract.
- **5.2** Successful Contractor may be notified of the time and place for the signing of contracts, essential requirements in the conduct of the contract, including, but not limited to, the number of days specified in the technical specifications for the performance of the contract, manner and schedule of payments, and other administrative details that will be reviewed at the award meeting.

6. AWARD OF CONTRACTS WHEN BIDS ARE EQUAL (N.J.S.A. 18A:18A-37(d)):

6.1 Whenever two or more responses to a request of a purchasing agent offer equal prices and are the lowest responsible bids , the District may award the contract to the Contractor whose response, in the discretion of the District, is the most advantageous, price and other factors considered.

7. LIQUIDATED DAMAGES (N.J.S.A. 18A:18A-41):

7.1 The District may act under the terms and conditions of this agreement, to assess reasonable liquidated damages for the violation of any of the terms and conditions, or the failure of the Contractor to perform said contract or agreement in accordance with the specifications. The monetary amount, if any to be assessed, will be indicated in the Technical Specifications Scope of Work Section of this document.

8. BUY AGAINST PROCEDURE:

8.1 If the items or services to be provided under this agreement are not delivered or provided within the time specified, the District reserves the right to obtain such items or services or any part thereof from other sources via a buy-against procedure. Should the new price be greater than the contract price, the difference in cost; and in addition, re-advertisement and possible liquidated damages will be charged against the Contractor. Should the price be less than the contract price, the Contractor shall have no claim to the difference, but the re-advertisement cost and possible liquidated damages will be charged against the Contractor.

9. PROHIBITIONS: HOLD HARMLESS

Contractors, with whom the District has an executed contract, may not subcontract any part of any work done for the District without first receiving written approval from the School Business Administrator. Contractors seeking to use subcontractors must first complete the Request for Subcontract Form as provided by the School Business Administrator.

In cases of subcontracting, the District shall only pay the prime Contractor. It is the sole responsibility of the prime Contractor to ensure that all subcontractors are paid. The District shall not be responsible for payments to subcontractors and shall be held harmless against any or all claims generated against prime Contractors for non-payments to subcontractors.

10. NON-COLLUSION AFFIDAVIT

A notarized Non-Collusion affidavit must be submitted with the bid.

11. CORPORATE OWNERSHIP DISCLOSURE (N.J.S.A. 52:25-24.2):

11.1 No corporation, partnership, or limited liability company shall be awarded any contract nor shall any agreement be entered into for the performance of any work or the furnishing of any materials or supplies, the cost of which is to be paid with or out of any public funds, by the State, or any county, municipality or school district, or any subsidiary or agency of the State, or of any county, municipality or school district, or by any authority, board, or commission which exercises governmental functions, unless prior to the receipt of the bid or accompanying the bid, of said corporation, said partnership, or said limited liability company there is submitted a statement setting forth the names and addresses of all stockholders in the corporation who own 10 percent or more of its stock, of any class, or of all individual partners in the partnership who own a 10 percent or greater interest therein, or of all members in the limited liability company who own a 10 percent or greater interest therein, as the case may be. If one or more such stockholder or partner or member is itself a corporation or partnership or limited liability company, the stockholders holding 10 percent or more of that corporation's stock, or the individual partners owning 10 percent or greater interest in that partnership, or the members owning 10 percent or greater interest in that limited liability company shall also be listed. The disclosure shall be continued until names and addresses of every non-corporate stockholder, and individual partner, and member, exceeding the 10 percent ownership criteria established in this act, have been listed.

To comply with this section, a bidder with any direct or indirect parent entity which is publicly traded may submit the name and address of each publicly traded entity and the name and address of each person that holds a 10 percent or greater beneficial interest in the publicly traded entity as of the last annual filing with the federal Securities and Exchange Commission or the foreign equivalent, and, if there is any person that holds a 10 percent or greater beneficial interest, also shall submit links to the websites containing the last annual filings with the federal Securities and Exchange Commission or the foreign equivalent and the relevant page numbers of the filings that contain the information on each person that holds a 10 percent or greater beneficial interest. Contained in this bid package is the FORM OF CORPORATE OWNERSHIP DISCLOSURE, which shall be completed by the bidder and attached to the bid.

12. <u>AFFIRMATIVE ACTION REGULATIONS</u> (N.J.S.A 10:5-31 et. seq.):

12.1 Contractors are required to comply with the State of New Jersey Affirmative Action Regulations (N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27). One of the following documents are due after notice of award, prior to signing the contract: Letter of Federal Approval, Certificate of Employee Information Report, or Complete AA302 Form.

13. <u>BUY AMERICAN GOODS</u> (N.J.S.A. 18A:18A-20):

13.1 Under the terms of this agreement, wherever available, and practical, the Contractor shall only use manufactured and farm products of the United States.

14. BRAND NAME OR EQUIVALENT (N.J.S.A. 18A:18A-15-d): (N/A)

- **14.1** The District may denote the use of brand names as a standard quality required by the District. However, the law states that brand name or equivalent be used by local boards of education in their Invitations to Bid.
- **14.2** All materials/supplies and/or equipment must conform to the specifications. The District may elect to return the sample or samples to the Contractor upon conclusion of the evaluation period.

15. NUMBER OF WORKING DAYS SPECIFIED (N.J.S.A. 18A:18A-19) (See technical Specifications)

15.1 All specifications for the doing of any work for the District shall have fixed in its detailed specifications, the date before which work shall be completed, or the number of days to be allowed for its completion.

16. <u>DURATION OF CONTRACTS</u> (N.J.S.A. 18A:18A-42): (See Technical Specifications)

17. INDEMNIFICATION:

17.1 The Contractor shall assume all risk of and responsibility for, and agrees to indemnify, defend, and save harmless the District and its employees from and against any and all claims, suits, actions recoveries, judgments and costs and expenses in connection therewith on account of the loss of life, property or injury to any person, body or property of any person or persons whatsoever, which may arise from or result directly or indirectly from the work and/or materials under this contract. This indemnification is not limited by but is in addition to the insurance obligations contained in this agreement.

18. ESTIMATED QUANTITIES: (N/A)

18.1 Contractors shall bid on the estimated quantities that have been supplied in the detailed specifications. The amounts (estimated) listed in the detailed specifications shall not be exceeded except by change order. The maximum amount of the change order(s) shall not exceed one hundred twenty percent (120%) of the estimated contract price. All change orders must be approved by the Department of Purchasing prior to exceeding any estimated quantities.

19. LIABILITY - COPYRIGHT:

19.1 The Contractor shall hold and save the District, its officers, agents, servants, and employees, harmless from liability of any nature or kind for or on account of the use of any copyrighted or non-copyrighted compensation, secret process, patented or unpatented invention, article or appliance furnished or used in the performance of the contract.

20. INSURANCE: (See Technical Specifications)

21. DELIVERY:

21.1 Unless otherwise specified in this bid, all prices in bids are to be submitted FREE ON BOARD (F.O.B.), DESTINATION (PATERSON PUBLIC SCHOOLS). Bids submitted other than F.O.B. DESTINATION may not be considered. Regardless of the method of quoting shipments, the Contractor shall assume all costs, liability and responsibility for the delivery of merchandise in good condition to the District using agency or Department of Purchasing.

- **21.2**. In all cases the transportation carrier is responsible for taking the material off or out of the delivery vehicle. The Contractor is responsible to the platform or loading dock for platform delivery, to the inside the building for inside delivery and to the designated area in the building for spotted delivery.
- **21.3** The successful Contractor guarantees delivery within the times specified in the bid documents. Failure to deliver items in the prescribed time shall cause the District to impose assessments as per the schedule listed in the bid documents.
- 21.4 Delivery times to all school buildings shall be from 8:30 a.m. to 4:30 noon, from Monday to Friday, except holidays.

22. REPORTING (N.J.S.A. 18A:18A-15): (N/A)

22.1 Should the cost of this contract for public work exceed \$20,000.00, the District, through its authorized agent, shall upon completion of the contract report to the department as to the Contractor's performance, and shall also furnish such report from time to time during performance if the Contractor is in default.

23. SUPPLIES AND MATERIAL CHARGES:

- **23.1** All material charges related to Time and Material Contracts, Material Contracts, or Supplies Contracts shall be percentages minus (-) the manufacturer's suggested retail price unless another specific criteria is listed in the technical specifications.
- **23.2** The cost of supplies or materials will include shipping, handling, storage, overhead and profit. The successful Contractor shall supply copies of all invoices to justify material costs.

24. RIGHT TO KNOW:

24.1 All potentially hazardous materials or substances must be properly labeled in full accordance with the New Jersey Right To Know Law, N.J.S.A. 34:5A-1 et seq.

25. PAYMENTS:

25.1 The District will pay the Contractor within (90) days from the receipt of the appropriate documentation described herein the Scope of Work. This documentation includes: the Contractor invoice with the purchase order number included and the ITB number, the purchase order Contractor declaration (voucher) signed by the Contractor, and the receiving copy of the purchase order signed by a District employee indicating the goods or services that were provided by the Contractor were received and satisfactory. All payments are subject to approval of the Board at a public meeting..

Contractors will be paid monthly. For some construction and other projects payment schedules will be developed with the using department, but in no circumstance shall the Contractor be paid unless the services have been rendered.

- Invoices shall be detailed and itemized and must include, where applicable, hourly rates, detailed material charges, dates, locations where the work was performed, type of work performed and time.
- Each invoice submitted by the Contractor must be accompanied by an originally signed and dated voucher. In addition, the Contractor must indicate the amount they are requesting to be paid on the signed voucher, which must coincide with the corresponding invoice.

To ensure compliance with N.J.A.C. 6A:23A-1.1 et seq. and in the effort to avoid future audit findings, Accounts Payable will not process payment packets that do not comply with the above two bullets. Noncompliance documents will be returned which will result in a payment delay.

ALL PAYMENT INQUIRIES SHALL BE DIRECTED TO PATERSON PUBLIC SCHOOLS, ACCOUNTS PAYABLE DEPARTMENT, (973) 321-0782/83/85/

26. ADDENDA AND INTERPRETATIONS

No interpretation of the meaning of the specifications or other contract documents will be made to any Bidder orally. Every request for such interpretation shall be in writing and e-mailed to Ms. Theresa Miller at tmiller@paterson.k12.nj.us. Questions should be asked in consecutive order, from beginning to end, following the organization of the ITB. Each question should begin by referencing the ITB page number and section number to which it relates. Any form or written addenda to the specifications, which if issued, will be e-mailed to all prospective bidders no later than seven (7) business days, not including Saturday, Sunday and holidays, prior to the date fixed for the opening of proposals. Failure of the Bidder to receive such addendum or interpretation shall not relieve any Bidder from any obligation under his/her bid as submitted. All addenda so issued shall become part of the contract documents. The cutoff for questions regarding this ITB is Thursday, May 15, 2025.

27. DEBARMENT, SUSPENSION, OR DISQUALIFICATION N.J.A.C. 17:19-4.1

The District will not enter into a contract for work with any person, company or firm that is on the State Treasurer's List of Debarred, Suspended or Disqualified Contractors or the State Department of Labor, Prevailing Wage Debarment List.

28. TAXES:

As a New Jersey governmental entity, the Board of Education is exempt from the requirements under New Jersey state sales tax (N.J.S.A. 54:32B-1 et seq.) and does not pay any sales or use taxes. Contractors should note that they are expected to comply with the provisions of said statute and the rules and regulations promulgated thereto to qualify them for examinations and reference to all labor, services, materials and supplies furnished to the District. Contractors may not use the Board's tax-exempt status to purchase supplies, materials, service or equipment.

29. NOTICE (AUTHORIZATION) TO PROCEED (N.J.S.A 18A:18A-36(b))

The Contractor, upon written request to the board of education, is entitled to receive, within seven days of the request, an authorization to proceed pursuant to the terms of the contract on the date set forth in the contract for work to commence, or, if no date is set forth on the contract, upon receipt of authorization. Authorization shall only be given to the Contractor in the form of an approved District purchase order. No word of mouth, phone, fax, e-mail, letter or other form of communication to proceed is a valid Notice to Proceed.

30. DEFERANCE TO TECHNICAL SPECIFICATIONS

Any conflicting terms and conditions set forth in the Technical Specifications supersede these General Specifications.

31. STATE OF NEW JERSEY BUSINESS REGISTRATION CERTIFICATE

The Board also requires that each Bidder complies with the current <u>New Jersey Business Registration Certificate</u> <u>procedures</u>, pursuant to N.J.S.A. 52:32-44. See page eleven (11) of the bid specification for additional information.

32. DISCLOSURE OF POLITICAL CONTRIBUTIONS

Pursuant to N.J.A.C. 6A:23A-6.3, business entities (contractors) entering non-emergency contracts with public school districts, are subject to the provisions of P.L. 2005, c. 271, s.2 (N.J.S.A. 19:44A-20.26), even when those contracts are publicly bid. N.J.S.A. 19:44A-20.26 provides that the contractor shall disclose contributions to:

- Any State, county, or municipal committee of a political party
- Any legislative leadership committee*
- Any continuing political committee (a.k.a., political action committee)
- Any candidate committee of a candidate for, or holder of, an elective office:
 - of the public entity awarding the contract
 - o of that county in which that public entity is located
 - of another public entity within that county
 - or of a legislative district in which that public entity is located or, when the public entity is a county, of any legislative district which includes all or part of the county

Under the statute, the disclosure must list reportable contributions to any of the committees that exceed \$300 per election cycle that were made during the 12 months prior to the award of the contract.

N.J.S.A. 19:44A-20.26 itemizes the parties from whom contributions must be disclosed when a business entity is not a natural person. This includes the following:

- individuals with an "interest" ownership or control of more than 10% of the profits or assets of a business entity or 10% of the stock in the case of a business entity that is a corporation for profit
- all principals, partners, officers, or directors of the business entity or their spouses
- any subsidiaries directly or indirectly controlled by the business entity

IRS Code Section 527 New Jersey based organizations, directly or indirectly controlled by the business entity and filing as continuing political committees, (PACs).

<u>N.J.S.A.</u> 19:44A-20.26 itemizes the parties from whom contributions must be disclosed when a business entity is not a natural person. This includes the following:

When the business entity is a natural person, "a contribution by that person's spouse or child, residing therewith, shall be deemed to be a contribution by the business entity." [N.J.S.A. 19:44A-20.26(b)] The contributor must be listed on the disclosure.

Any business entity that fails to comply with the disclosure provisions shall be subject to a fine imposed by ELEC in an amount determined by the Commission, which may be based upon the amount that the business entity failed to report.

The enclosed list of agencies is provided to assist the Contractor in identifying those public agencies whose elected official and/or candidate campaign committees are affected by the disclosure requirement. It is the Contractor's responsibility to identify the specific committees to which contributions may have been made and need to be disclosed. The disclosed information may exceed the minimum requirement.

The Contractor is advised of the responsibility to file an annual disclosure statement on political contributions with the New Jersey Election Law Enforcement Commission pursuant to N.J.S.A. 19:44A-20.27. P.L. 2005, c271, s.3 PPS Policy #6361 states that: ("Contributions [...] to any member of the school Board from any business entity doing business with the school district are prohibited during the term of a contract"). Furthermore, it prohibits the district from engaging a prospective contract worth more than \$17,500 if that Contractor has contributed more than \$300 to a board member's campaign in the year prior to the one in which the Board votes upon or awards the contract.

("The Board will not vote upon or award any contract in the amount of \$17,500 or greater to any business entity which has made a contribution [of more than \$300] to a member of the Board of Education during the preceding one-year period.")

Accordingly, here in the District, <u>current Contractors</u> cannot contribute more than \$300 to the board election campaign of a candidate, and if a <u>prospective Contractor</u> contributes between \$300 and \$2,600 to a candidate, the candidate must report the contribution to ELEC, and the Board must wait one year before accepting the prospective Contractor's bid for a contract worth more than \$17,500.

<u>33</u> <u>PRE-BID CONFERENCE/MEETING</u> The pre-bid conference attendance is not mandatory, but it is strongly recommended. Failure to attend does not relieve the Bidder of any obligations or requirements.

34. DOCUMENT RETENTION

"(The contract partner) shall maintain all documentation related to products, transactions or services under this contract for a period of seven years from the date of final payment. Such records shall be made available to the New Jersey Office of the State Comptroller upon request."

35. ANTI-DISCRIMINATION- (N.J.S.A. 10:2-1)

During the term of the contract the Contractor agrees that:

- a. In the hiring of persons for the performance of work under this contract or any subcontract hereunder, or for the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under this contract, no Contractor, nor any person acting on behalf of such Contractor or subcontractor, shall, by reason of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex, discriminate against any person who is qualified and available to perform the work to which the employment relates;
- b. No Contractor, subcontractor, nor any person on his behalf shall, in any manner, discriminate against or intimidate any employee engaged in the performance of work under this contract or any subcontract hereunder, or engaged in the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under such contract, on account of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex;
- c. There may be deducted from the amount payable to the Contractor by the contracting public agency, under this contract, a penalty of \$ 50.00 for each person for each calendar day during which such a person is discriminated against or intimidated in violation of the provisions of the contract; and
- d. This contract may be canceled or terminated by the contracting public agency, and all money due or to become due hereunder may be forfeited, for any violation of this section of the contract occurring after notice to the Contractor from the contracting public agency of any prior violation of this section of the contract.

37 ANTI-BULLYING

Pursuant to N.J.S.A. 18A:37-16, a contracted service provider who has witnessed, or has reliable information that a student has been subject to harassment, intimidation or bullying shall report the incident to the appropriate school official designated by the school District's policy, or to any school administrator or safe schools resource officer.

38. PREVAILING WAGES (N.J.S.A. 34:11-56.25 et esq.)

Bidders shall comply with the State of New Jersey Prevailing Wage Act for public works, if applicable, and will be required to show proof of prevailing wages to any and all employees involved in the performance of this contract. Bidders are encouraged to contact the New Jersey Department of Labor, Prevailing Wage Rate Determination Office and request current copies of the Passaic County wage and benefits rates. The successful Bidder (Contractor) shall submit certified payrolls for public works, if applicable, to the Director of Facilities to obtain payment under the awarded contract. Failure to submit certified payrolls for public works will result in the District withholding payments.

39. NOTICE OF CLASSIFICATION (For Public Works exceeding \$20,000) (N.J.S.A. 18A:18A-26)

Each Bidder shall submit with his/her bid a copy of a valid and active pre-qualification/classification letter issued by the Department of Transportation or the Department of Treasury (Division of Building and Construction of the State of New Jersey) as appropriate to the nature of the bid. Any bid submitted to a school board under the terms of New Jersey Statues not including a copy of a valid and active pre-qualification/classification letter shall be rejected as being non-responsive to bid requirements.

40. <u>UNCOMPLETED CONTRACTS</u> (For contracts exceeding \$20,000) N.J.A.C 17:19-2.13

The Board also requires that each Bidder submit with his/her bid a <u>Certified Total Amount of Uncompleted</u> Contracts form as prescribed by law.

41. ASSIGNMENTS/SUBCONTRACTING:

The Contractor shall not assign or subcontract the whole or any part of this contract without the prior written permission of the District. Any payments under this contract shall be paid to the primary Contractor. No payments will be made to the subcontractor. This may be adjusted by the technical specifications.

42. LIST OF SUBCONTRACTORS

If applicable, all Bidders shall submit a list of subcontractors specifying the dollar amount for each trade. (See attached form).

- 43. <u>SUBCONTRACTING</u>: <u>Subcontractor Disclosure Statement</u> Pursuant to NJSA 18A:18A-18(b) any Bidder who bids for the overall contract and who will subcontract the following work:
- Plumbing and gas fitting work and all kindred work;
- Heating and ventilating systems and equipment;
- Electrical work
 - Structural steel and ornamental iron work; Shall identify the subcontractor that will be used on the form provided.
- 44. <u>QUALIFIED SUBCONTRACTORS</u> If the cost of the work done by the subcontractors exceed \$20,000.00, then said Contractor shall be qualified in accordance with article 6, N.J.S.A. 18A:18A-27 et. Seq. The Bidder shall supply proof that the subcontractor is qualified by submitting <u>with the bid</u> the subcontractor's:
- Notice of Classification
- Total Amount of uncompleted Contractors Form Certified
- Contractor's Registration Certificate
- Current license(s) to perform the work described under this bid.

NO EXCEPTIONS

45. AUDIT BY OFFICE OF THE STATE COMPTROLLER; N.J.A.C. 17:44-2.2

Relevant records of private Contractors or other persons entering contracts with covered entities are subject to audit or review by OSC pursuant to N.J.S.A. 52:15C-14(d).

The Contractor shall maintain all documentation related to products, transactions or services under contract for a period of seven years from the date of final payment. Such records shall be made available to the New Jersey Office of the State Comptroller upon request.

46. CRIMINAL HISTORY BACKGROUND CHECK; N.J.S.A. 18A:6-7.1

Bidders must comply with the following: A facility, center, school, or school system under the supervision of the Department of Education and board of education which cares for, or is involved in the education of children under the age of 18 shall not employ for pay or contract for the paid services of any teaching staff member or substitute teacher, teacher aide, child study team member, school physician, school nurse, custodian, school maintenance worker, cafeteria worker, school law enforcement officer, school secretary or clerical worker or any other person serving in a position which involves regular contact with pupils unless the employer has first determined consistent with the requirements and standards of this act, that no criminal history record information exists on file in the Federal Bureau of Investigation, Identification Division, or the State Bureau of Identification which would disgualify that individual from being employed or utilized in such capacity or position. An individual employed by a board of education or a school bus Contractor holding a contract with a board of education, in the capacity of a school bus driver, shall be required to meet the criminal history record requirements pursuant to section 6 of P.L.1989, c.104 (C.18A:39-19.1). A facility, center, school, or school system under the supervision of the Department of Education and board of education which cares for or is involved in the education of children under the age of 18 may require criminal history record checks for individuals who, on an unpaid voluntary basis, provide services that involve regular contact with pupils. In the case of school districts involved in a sending-receiving relationship, the decision to require criminal history checks for volunteers shall be made jointly by the boards of education of the sending and receiving districts.

*** END OF GENERAL SPECIFICATIONS ****



AFFRMATIVE ACTION

- MANDATORY AFFIRMATIVE LANGUAGE
- AMERICANS WITH DISABILITIES ACT OF 1990



EXHIBIT A

MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE N.J.S.A. 10:5-31 et seq. (P.L. 1975, C. 127) N.J.A.C. 17:27

GOODS, PROFESSIONAL SERVICE AND GENERAL SERVICE CONTRACTS

During the performance of this contract, the contractor agrees as follows:

The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the contractor will take affirmative action to ensure that such applicants are recruited and employed, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such actions shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex.

The contractor or subcontractor, where applicable, will send to each labor union or representative or workers with which it has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer advising the labor union or workers' representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act.

The contractor or subcontractor agrees to make good faith efforts to employ minority and women workers consistent with the applicable county employment goals established in accordance with N.J.A.C. I7:27-5.2, or a binding determination of the applicable county employment goals determined by the Division, pursuant to N.J.A.C. 17:27-5.2.

The contractor or subcontractor agrees to inform in writing its appropriate recruitment agencies including, but not limited to, employment agencies, placement bureaus, colleges, universities, labor unions, that it does not discriminate on the basis of age, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex, and that it will discontinue the use of any recruitment agency which engages in direct or indirect discriminatory practices.

The contractor or subcontractor agrees to revise any of its testing procedures, if necessary, to ensure that all personnel testing conforms with the principles of job-related testing, as established by the statutes and court decisions of the State of New Jersey and as established by applicable Federal law and applicable Federal court decisions.

In conforming with the applicable employment goals, the contractor or subcontractor agrees to review all procedures relating to transfer, upgrading, downgrading and layoff to ensure that all such actions are taken without regard to age, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex, consistent with the statutes and court decisions of the State of New Jersey, and applicable Federal law and applicable Federal court decisions.

The contractor shall submit to the public agency, after notification of award but prior to execution of a goods and services contract, one of the following three documents:

Letter of Federal Affirmative Action Plan Approval

Certificate of Employee Information Report

Employee Information Report Form AA302

The contractor and its subcontractors shall furnish such reports or other documents to the Div. of Contract Compliance & EEO as may be requested by the office from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Div. of Contract Compliance & EEO for conducting a compliance investigation pursuant to **Subchapter 10 of the Administrative Code at N.J.A.C.** 17:27.

AMERICANS WITH DISABILITIES ACT OF 1990

APPENDIX A AMERICANS WITH DISABILITIES ACT OF 1990 Equal Opportunity for Individuals with Disability

The contractor and the Paterson Public School District of the county of Passaic, (hereafter "owner") do hereby agree that the provisions of Title 11 of the Americans With Disabilities Act of 1990 (the "Act") (42 U.S.C. S121 01 et seq.), which prohibits discrimination on the basis of disability by public entities in all services, programs, and activities provided or made available by public entities, and the rules and regulations promulgated pursuant there unto, are made a part of this contract. In providing any aid, benefit, or service on behalf of the owner pursuant to this contract, the contractor agrees that the performance shall be in strict compliance with the Act. If the contractor, its agents, servants, employees, or subcontractors violate or are alleged to have violated the Act during the performance of this contract, the contractor shall defend the owner in any action or administrative proceeding commenced pursuant to this Act. The contractor shall indemnify, protect, and save harmless the owner, its agents, servants, and employees from and against all suits, claims, losses, demands, or damages, of whatever kind or nature arising out of or claimed to arise out of the alleged violation. The contractor shall, at its own expense, appear, defend, and pay all charges for legal services and all costs and other expenses arising from such action or administrative proceeding or incurred in connection therewith. In all complaints brought pursuant to the owner's grievance procedure, the contractor agrees to abide by any decision of the owner which is rendered pursuant to said grievance procedure. If any action or administrative proceeding results in an award of damages against the owner, or if the owner incurs any expense to cure a violation of the ADA which has been brought pursuant to its grievance procedure, the contractor shall satisfy and discharge the same at its own expense.

The owner shall, as soon as practicable after a claim has been made against it, give written notice thereof to the contractor along with full and complete particulars of the claim, If any action or administrative proceeding is brought against the owner or any of its agents, servants, and employees, the *owner shall* expeditiously forward or have forwarded to the contractor every demand, complaint, notice, summons, pleading, or other process received by the owner or its representatives.

It is expressly agreed and understood that any approval by the owner of the services provided by the contractor pursuant to this contract will not relieve the contractor of the obligation to comply with the Act and to defend, indemnify, protect, and save harmless the owner pursuant to this paragraph.

It is further agreed and understood that the owner assumes no obligation to indemnify or save harmless the contractor, its agents, servants, employees and subcontractors for any claim which may arise out of their performance of this Agreement. Furthermore, the contractor expressly understands and agrees that the provisions of this indemnification clause shall in no way limit the contractor's obligations assumed in this Agreement, nor shall they be construed to relieve the contractor from any liability, nor preclude the owner from taking any other actions available to it under any other provisions of the Agreement or otherwise at law.



POLITICAL CONTRIBUTION DISCLOSURE FORM

• Contractor Instructions for School Districts



POLITICAL CONTRIBUTION DISCLOSURE FORM

Contractor Instructions For School Districts

Pursuant to N.J.A.C. 6A:23A-6.3, business entities (contractors) entering non-emergency contracts with public school districts, are subject to the provisions of P.L. 2005, c. 271, s.2 (N.J.S.A. 19:44A-20.26), even when those contracts are publicly bid. N.J.S.A. 19:44A-20.26 provides that the contractor shall disclose contributions to:

- Any State, county, or municipal committee of a political party
- Any legislative leadership committee*
- Any continuing political committee (a.k.a., political action committee)
- Any candidate committee of a candidate for, or holder of, an elective office:
 - o of the public entity awarding the contract
 - o of that county in which that public entity is located
 - o of another public entity within that county
 - or of a legislative district in which that public entity is located or, when the public entity is a county, of any legislative district which includes all or part of the county

Under the statute, the disclosure must list reportable contributions to any of the committees that exceed \$300 per election cycle that were made during the 12 months prior to the award of the contract.

N.J.S.A. 19:44A-20.26 itemizes the parties from whom contributions must be disclosed when a business entity is not a natural person. This includes the following:

- individuals with an "interest" ownership or control of more than 10% of the profits or assets of a business entity or 10% of the stock in the case of a business entity that is a corporation for profit
- all principals, partners, officers, or directors of the business entity or their spouses
- any subsidiaries directly or indirectly controlled by the business entity

IRS Code Section 527 New Jersey based organizations, directly or indirectly controlled by the business entity and filing as continuing political committees, (PACs).

<u>N.J.S.A.</u> 19:44A-20.26 itemizes the parties from whom contributions must be disclosed when a business entity is not a natural person. This includes the following:

When the business entity is a natural person, "a contribution by that person's spouse or child, residing therewith, shall be deemed to be a contribution by the business entity." [N.J.S.A. 19:44A-20.26(b)] The contributor must be listed on the disclosure.

Any business entity that fails to comply with the disclosure provisions shall be subject to a fine imposed by ELEC in an amount determined by the Commission, which may be based upon the amount that the business entity failed to report.

The enclosed list of agencies is provided to assist the Contractor in identifying those public agencies whose elected official and/or candidate campaign committees are affected by the disclosure requirement. It is the Contractor's responsibility to identify the specific committees to which contributions may have been made and need to be disclosed. The disclosed information may exceed the minimum requirement.

C. 271 POLITICAL CONTRIBUTION DISCLOSURE FORM

Contractor Instructions For School Districts

The enclosed Political Contribution Disclosure Form or a content-consistent facsimile (along with a signed cover sheet) must be submitted with the Contractor's bid and is disclosable to the public under the Open Public Records Act.

The Contractor must also complete the attached Stockholder Disclosure Certification. This will assist the agency in meeting its obligations under the law. N.J.S.A. 19:44A-3(s): "The term "legislative leadership committee" means a committee established, authorized to be established, or designated by the President of the Senate, the Minority Leader of the Senate, the Speaker of the General Assembly or the Minority Leader of the General Assembly pursuant to section 16 of P.L.1993, c.65 (C.19:44A-10.1) for the purpose of receiving contributions and making expenditures."

List of Agencies with Elected Officials Required for Political Contribution Disclosure N.J.S.A. 19:44A-20.26

County Name: Passaic

State: Governor, and Legislative Leadership Committees

Legislative District #: 35 State Senator and two members of the General Assembly per district.

County:

Freeholders County Clerk Sheriff

Surrogate Registrar of Deeds

Municipalities (Mayor and members of governing body, regardless of title):

Bloomingdale Borough	Passaic City	Wanaque Borough
Clifton City	Paterson City	Wayne Township
Haledon Borough	Pompton Lakes Borough	West Milford Township
Hawthorne Borough	Prospect Park Borough	Woodland Park Borough
Little Falls Township	Ringwood Borough	
North Haledon Borough	Totowa Borough	

Boards of Education (Members of the Board):

Bloomingdale Borough	Passaic City	Totowa Borough
Clifton City	Passaic County Manchester Regional	Wanaque Borough
Haledon Borough	Passaic Valley Regional	Wayne Township
Hawthorne Borough	Paterson City	West Milford Township
Lakeland Regional	Pompton Lakes Borough	Woodland Park Borough
Little Falls Township	Prospect Park Borough	
North Haledon Borough	Ringwood Borough	

Fire Districts (Board of fire Commissioners): None



Technical Specifications



SECTIONS

- SECTION 1 INFORMATION TO BIDDERS
- SECTION 2 SCOPE OF WORK

<u>Technical Specifications - Section 1: Information to Bidders</u>

1 PURPOSE AND INTENT

This Invitation to Bid (ITB) is issued by the Paterson Public School System (herein the "District"), **Department of Purchasing**. The intent of this Invitation is to award a Bid Contract to that responsible bidder whose proposal, conforms to all of the District's Technical Specifications. **It is the intent of the "District" to award a contract to a SINGLE (primary contractor)**. A secondary contractor will be selected a contract if it is found to be necessary. The District will select the most capable Contractor whose bid proposal demonstrates their ability to satisfy the specific terms, conditions, and requirements as specified in this document. The successful bidder shall provide all labor, materials, and equipment necessary to perform inspection, testing, maintenance, and repairs on all **District Boiler Systems** This will be to the satisfaction of the "**District"** and in accordance with applicable laws, codes, standards, terms and conditions, and specifications outlined in this **Invitation for Bid**.

The expected service is described in Part 2 of the Technical Specifications (Scope of Work).

1.2 KEY EVENTS

1.2.1 **PRE-BID CONFERENCE:**

It is **STRONGLY RECOMMENDED** that potential Bidders attend the Pre-Bid Conference for purposes of clarifying specific information concerning the project work, hearing other Bidders' questions regarding various aspects of the Project and the answers thereto, and learning the manner of proper completion and submission of the Bid Documents to ensure a responsive Bid. **Failure to attend does not relieve the bidder of any obligations or requirements.**

DATE/TIME:	Tuesday, May 13, 2025 at 10:00 AM
	EASTSIDE HIGH SCHOOL
LOCATION	150 Park Avenue
	Paterson, NJ

1.2.2 Bid Opening:

In order to be considered for award, the bid must be received by the Paterson Public School District, Department of Purchasing at the appropriate location by the required time. **ANY BID NOT RECEIVED ON TIME AT THE RIGHT PLACE WILL BE REJECTED. THE DATE, TIME AND LOCATION ARE**:

DATE & TIME:	Wednesday, May 28, 2025 at 10:00 AM
LOCATION:	LIVESTREAM-ZOOM https://us04web.zoom.us/j/871855428 PASSWORD: 5050

The information required to be submitted in response to this invitation to bid has been determined to be essential in the bid evaluation and contract award process. Any exception statements made by the Bidder to the bid requirements could result in a determination that the bid is materially non-responsive.

1.3 BID DELIVERY AND IDENTIFICATION

To be considered, a bid must arrive at the District, in accordance with the instructions on the BID cover sheet. Bidders submitting bids are cautioned to allow adequate delivery time to ensure timely delivery of bids. No bids shall be received after the time designated in the advertisement in accordance with N.J.S.A. 18A:18A-21(b). THE EXTERIOR OF ALL BID RESPONSE PACKAGES MUST BE LABELED WITH THE BID IDENTIFICATION NUMBER, BID TITLE, FINAL BID OPENING DATE AND THE BUYER'S NAME. NO EXCEPTIONS.

1.4 <u>NUMBER OF BID COPIES</u> (1 ORIGINAL, 1 COPY ON A USB) PLEASE ENSURE A USB, WITH YOUR COMPLETE PROPOSAL, IS DOWNLOADED AND INCLUDED WITH YOUR BID.

Each Bidder must submit **one (1) complete NON-BOUND ORIGINAL bid**, clearly marked as the "ORIGINAL" bid. Each Bidder should submit **ONE (1) FULL, COMPLETE AND EXACT COPY ON A USB** of the original. Bidders failing to provide the requested number of copies will be charged the cost incurred by the District to produce the requested number of copies. It is suggested that the Bidder make and retain a copy of its bid.

1.5 BIDDER RESPONSIBILITY

The Bidder assumes sole responsibility for the complete effort required in this bid. No special consideration shall be given after bids are opened because of a Bidder's failure to be knowledgeable of all the requirements of this bid. By submitting a bid in response to this ITB, the Bidder represents that it has satisfied itself, from its own investigation, of all the requirements of this bid.

1.6 COST LIABILITY

The District assumes no responsibility and bears no liability for costs incurred by Bidders before the award of the contract resulting from this bid.

1.7 CONTENTS OF BID

The entire content of every bid will be publicly opened and becomes a public record. This is the case notwithstanding any statement to the contrary made by a Bidder in its bid. All bids, as public records, are available for public inspection. Interested parties can make an appointment with the Purchase Bureau buyer to inspect bids received in response to this BID.

1.8 PRICE ALTERATION

Bid prices must be typed or written in ink. Any price change (including "white-outs") must be initialed. Failure to do so may preclude an award being made to the Bidder.

1.9 DURATION OF CONTRACTS (N.J.S.A. 18A:18A-42)

The Contractor shall provide the specified goods and/or services for one (1) year: **2024-2025 school year**, with an option for a renewal as described in the "Contract Renewal" Section. The original term of this contract and any extension are subject to the availability and appropriation annually of sufficient funds.

1.10 ESTIMATED CONTRACT

The District estimates expenditures under this contract to be over the bid threshold during the term of the contract. The District reserves the right to increase or decrease this amount based upon need and funding during the term of the contract.

1.11.1 CONTRACT RENEWAL

Following its initial term, the contract may be extended substantially to the same terms and conditions if the District determines that the Contractor has provided services in an effective and efficient manner. The allowable extended duration of this contract may be for a (1) one-year or (2) two-year extension.

Subject to the following limitations:

- a. the contract shall be awarded by resolution of the board of education upon a finding by the board of education that the services are performed in an effective and efficient manner.
- b. no such contract shall be extended so that it runs for more than a total of five consecutive years.
- c. any price change included as part of an extension shall be based upon the price of the original contract as cumulatively adjusted pursuant to any previous adjustment or extension and shall not exceed the change in the index rate for the 12 months preceding the most recent quarterly calculation available at the time the contract is renewed; and
- d. the terms and conditions of the contract remain substantially the same.

1.11.2. CONTRACT EFFECTIVE DATES

Any contract entered into as a result of these bid specifications shall cease to have effect at the end of the contracted period and shall not be extended by any mechanism or provision, unless in conformance with the "Public School Contracts Law," *N.J.S.A.*18A:18A-1 *et seq.*, except that a contract may be extended by mutual agreement of the parties to the contract when the Paterson Board of Education has commenced rebidding prior to the time the contract expires or when the awarding of a contract is pending at the time the contract expires.

SUBMISSION OF BID DEPOSITS AND BID BONDS (N.J.S.A.18A:18A-24):

As evidence of good faith, a BID BOND shall accompany each bid or CERTIFIED CHECK made payable to PATERSON PUBLIC SCHOOLS, equal to ten percent (10%) of the Contractor's bid. However, in no case will this bid deposit or certified check, or any combination thereof exceed twenty thousand dollars (\$20,000.00).

1.12.2 CERTIFICATE FROM SURETY COMPANY (NJSA 18A: 18A-25)

Each Bidder must submit with his/her bid a certificate from a surety company stating that the surety company will provide the Contractor with a performance bond in an amount equal to the amount of the contract (N.J.S.A. 18A 18A-25). Failure to submit the certificate (Consent) of Surety shall be cause for rejection of bid.

1.12.3 PERFORMANCE BONDS (N.J.S.A. 18A: 18A-25)

The successful Bidder shall furnish within ten (10) business days after the notice of the contract award a Performance Bond in statutory form in an amount equal to one hundred percent (100%) of the total contract price as security for faithful performance of this contract.

1.13 AWARD OF CONTRACT

In executing the contract, the successful Bidder agrees to perform all work in accordance with the terms and conditions of the specifications to the reasonable satisfaction of the District and to complete all work and/or services as specified in the contract. Successful Bidder will be notified of the time and place for the signing of contracts, essential requirements in the conduct of the contract, including, but not limited to, the number of days specified in the technical specifications for the performance of the contract, manner and schedule of payments, and other administrative details that will be reviewed at the award meeting. Refer to section 2 of Technical Specifications.

1.14 AWARD CRITERIA

Bids will be awarded to a qualified Contractor who is the lowest responsible Bidder as defined under, and in accordance with, the Public School Contracts Law, *N.J.S.A.* 18A:18A-1, *et seq.*.

1.15 ADDENDA AND INTERPRETATIONS

No interpretation of the meaning of the specifications or other contract documents will be made to any Bidder orally. Notice of revisions or addenda to advertisements or bid documents shall be issued in accordance with N.J.S.A. 18A:18A-21c(1). Failure of any Bidder to receive such addendum or interpretation shall not relieve any Bidder from any obligation under his/her bid as submitted. All addenda so issued shall become part of the contract documents.

1.16 QUESTION PROTOCOL

Questions can be e-mailed to (tmiller@paterson.k12.nj.us) in writing to the attention of the assigned Purchasing staff. Written questions should reference the bid. Questions should be asked in consecutive order, from beginning to end, following the organization of the bid. Each question should begin by referencing the bid page number and section number to which it relates. Short procedural inquiries may be accepted by telephone by the assigned purchasing staff. However, oral explanations or instructions given over the telephone shall not be binding upon the District. Bidders shall not contact the Using Department directly, in person, or by telephone, concerning this bid.

1.17 SHIPPING AND HANDLING CHARGES

Shipping and handling charges are included in price. The Bidder shall not process any order or purchase that includes shipping and handling charges. The District shall seek reimbursement for all shipping and handling applied to any purchase(s).

1.18 DELIVERY

Unless otherwise specified in this ITB, all prices in bids are to be submitted FREE ON BOARD (F.O.B.), DESTINATION (PATERSON PUBLIC SCHOOLS). Bids submitted other than F.O.B. DESTINATION may not be considered. Regardless of the method of quoting shipments, the Contractor shall assume all costs, liability and responsibility for the delivery of merchandise in good condition to the District using agency or Department of Purchasing.

In all cases the transportation carrier is responsible for taking the material off or out of the delivery vehicle. The Contractor is responsible to the platform or loading dock for platform delivery, to the inside the building for inside delivery and to the designated area in the building for spotted delivery.

If specialized personnel are needed to set up, assemble, or erect an item, such action will be completed in five (5) business days. The District will impose a \$100 per day assessment against the Bidder for failure to comply within this time limit.

The successful Bidder guarantees delivery within the times specified in the bid documents. Failure to deliver items in the prescribed time shall cause the District to impose assessments as per the schedule listed in the bid documents. Delivery times to all school buildings shall be from 8:30 a.m. to 4:30 p.m. from Monday to Friday, except holidays.

1.19 INSURANCE REQUIREMENTS

The Contractor shall secure and maintain in force and effect for the term of this contract, liability insurance as provided below, unless revised in the technical specifications. The Contractor shall provide the District with current certificates for all coverage and renewals thereof, which must contain the provision that the insurance in the certificate shall not be cancelled for any reason except after thirty (30) days written notice to:

PATERSON PUBLIC SCHOOLS

DEPARTMENT OF PURCHASING, 4TH FLOOR 90 DELAWARE AVENUE, PATERSON, NJ 07503

1. Minimum Coverage:

General Liability Insurance - Including personal injury, equipment & property damage		
Aggregate	\$5,000,000 – Annual Basis	
Each Occurrence	\$ 1,000,000	
Fire	\$50,000	
Medical	\$5,000	

Automobile Liability – including personal injury and property damage	
Combined Limit	\$ 1,000,000 - Annual Basis

Worker's Compensation & Employer's Liability	
Each Accident	Statutory
Disease	Statutory

2. A Certificate of Insurance, which names the District as an additional named insured, shall be furnished by the Board at the time the contract is signed.

1.20 DEFINITIONS

1.20.1 GENERAL DEFINITIONS

The following definitions shall be part of any contract awarded, or order placed because of this Bid.

Addendum – Written clarification or revision to this ITB issued by the District.

Amendment – A change in the scope of work to be performed by the Contractor.

Bidder - An individual or business entity submitting a response to this ITB.

Contract - The written executed agreement between the parties, this ITB, any addendum to this ITB, and the Bidder's bid submitted in response to this ITB, as accepted by the District.

Contractor - The successful Bidder awarded a contract.

District- The entire Paterson Public School System

May - Denotes that which is permissible, not mandatory.

Project - The undertaking or services that are the subject of this ITB.

Invitation to Bid (ITB) – This document which establishes the bidding and contract requirements and solicits bids to meet the purchase needs of the using agencies as identified herein.

Shall or Must – Denotes that which is a mandatory requirement. Failure to meet a mandatory requirement will result in the rejection of a bid as materially non-responsive.

Should - Denotes that which is recommended, not mandatory.

District Contract Manager (DCM) – The individual responsible for the approval of all deliverables, i.e., tasks, sub-tasks or other work elements in the Scope of Work.

Subtasks – Detailed activities that comprise the actual performance of a task.

Task - A discrete unit of work to be performed.

Using Department - The entity for which the District has issued this bid and will enter a contract.

1.21 CONTRACT CONTINGENT ON AVAILABLE FUNDS / CANCELLATION CLAUSE

As per *N.J.S.A.* 18A:18A-42, the District entering a contract under these bid specifications, as well as any additional contract extensions, shall be subject to the availability of sufficient funds and appropriation annually of sufficient funds as may be required to meet the extended obligation. The District retains the sole discretion to cancel any contract or bid specifications when there are no sufficient funds available or when there is no annual appropriation for sufficient funds to cover the costs of the contract.

SECTION 2: SCOPE OF WORK

Technical Specifications - Section 2: Scope of Work

SEE PROJECT MANUAL AND SPECIFICATIONS



BID PROPOSAL AND REQUIRED DOCUMENTS

Submit one (1) original bid packet (stapled to cover) and one (1) Electronic Copy USB.



BID RETURN BOOKLET

Please Complete

Bid Title:	
Bid Number:	
Company Name	
□ Bid Return Booklet If submitting a bid, kindly attach and staple all pages marked "Require to this page. One(1) original, one(1) electronic copy (USB,FLASH I	
No Bid If you do not wish to submit a bid at this time but would like to remain Bidder's list, return this form to the Paterson Public School District.	in the District
Reason for not bidding:	
Check Remove from List If you wish to be removed from the District's Bidder's list do not reply to bid.	o this invitation
Company Representative ATTACH AND STAPLE ALL REQUIRED DOCUMENTATION TO THIS PAGE	Date

BID RETURN

THE FOLLOWING DOCUMENTS ARE <u>MANDATORY</u> ATTACHMENTS AND FAILURE TO SUBMIT THEM MAY BE CAUSE FOR DISQUALIFICATION FOR BEING NON-RESPONSIVE AND REJECTION OF THE BID.

SUBMISSION CHECKLIST

PLEASE SUBMIT YOUR BID IN THE FOLLOWING ORDER:

Bid Security / Bid Bond

Performance Bond (Shall be furnished ten (10) business days after notice of contract award)

Consent of Surety

Statement of Ownership Disclosure

Affirmative Action Requirements (Form AA302 Form or current Employee Information Report)

-Required for the successful Bidder.

Equal Opportunity Language – Compliance Notice

New Jersey Business Registration Certificate, (FORM-BRC-(08-01) – provide prior to contract award

Non-Collusion Affidavit

Company Information Form

W-9 Form

Reference Sheet

Equipment / Prevailing Wage/Unauthorized Orders Certification Form

Political Contribution Disclosure Form

Disclosure of Investment Activities in Iran - provide prior to contract award

Certification of Non-involvement in Prohibited Activities in Russia or Belarus

Acknowledgement of Receipt of Addenda-Please still fill out if no addenda has been issued

Contractors Qualification Statement (SEE ATTACHED SAMPLE)

Pricing Sheet

Notice of Classification from the State (NO EXCEPTIONS)

Notarized Amount of Uncompleted Contracts from the State (NO EXCEPTIONS)

Public Works Contractor Certificate (NO EXCEPTIONS)

List of Subcontractors, if any (PLEASE READ PAGE 16, NUMBERS 43 & 44 REGARDING

SUBCONTRACTING (NO EXCEPTIONS)

Copy(ies) of current license(s) to perform under this contract

BID AND PERFORMANCE BOND REQUIREMENTS FOR THIS ITB

Bid Bond Amount: 10% of total bid amount, not to exceed \$20,000.00 dollars

Performance Bond: 100% of contract value

The undersigned declares that he/she has read the specifications and included all items listed in the Checklist above.



Contractor's Qualification Statement

THE PARTIES SHOULD EXECUTE A SEPARATE CONFIDENTIALITY AGREEMENT IF THEY INTEND FOR ANY OF THE INFORMATION IN THIS A305-2020 TO BE HELD CONFIDENTIAL.

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SUBMITTED TO:

(Organization name and address.)

(Organization name and address.)

This document has important legal consequences.
Consultation with an attorney is encouraged with respect to its completion or modification.

TYPE OF WORK TYPICALLY PERFORMED

(Indicate the type of work your organization typically performs, such as general contracting, construction manager as constructor services, HVAC contracting, electrical contracting, plumbing contracting, or other.)

contracting, plun	nbing contracting, or other.)	
THIS CONTRACT (Check all that a	OR'S QUALIFICATION STATEMENT INCLUDES THE FOLLOWING: pply.)	
	Exhibit A – General Information	
	Exhibit B – Financial and Performance Information	
	Exhibit C – Project-Specific Information	
	Exhibit D – Past Project Experience	
	Exhibit E – Past Project Experience (Continued)	
true and sufficient	certifies under oath that the information provided in this Contractor's Qualification Statement is ntly complete so as not to be misleading. uthorized Representative Signature Date	
Printed Name and	d Title	
NOTARY State of: County of: Signed and sworn to before me this day of Notary Signature		
, , ,		

Init.

My commission expires:

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STATEMENT OF OWNERSHIP DISCLOSURE
N.J.S.A. 52:25-24.2 (P.L. 1977, c.33, as amended by P.L. 2016, c.43)

This statement shall be completed, certified to, and included with all bid submissions. Failure to submit the required information is cause for automatic rejection of the bid .

Name of Organization:	
Organization Address:	
Part I Check the box that represents th	e type of business organization:
Sole Proprietorship (skip Parts II and II	I, execute certification in Part IV)
Non-Profit Corporation (skip Parts II ar	nd III, execute certification in Part IV)
For-Profit Corporation (any type)	Limited Liability Company (LLC)
Partnership Limited Partnership	Limited Liability Partnership (LLP)
Other (be specific):	
Part II	
more of its stock, of any class, or of a interest therein, or of all members in t	d addresses of all stockholders in the corporation who own 10 percent or ll individual partners in the partnership who own a 10 percent or greater the limited liability company who own a 10 percent or greater interest LETE THE LIST BELOW IN THIS SECTION)
partner in the partnership owns a 10 p	n owns 10 percent or more of its stock, of any class, or no individual percent or greater interest therein, or no member in the limited liability in interest therein, as the case may be. (SKIP TO PART IV)
(Please attach additional sheets if more space is no	eeded):
Name of Individual or Business Entity	Home Address (for Individuals) or Business Address

ATTACH AND STAPLE ALL REQUIRED DOCUMENTATION TO THIS PAGE

Part III DISCLOSURE OF 10% OR GREATER OWNERSHIP IN THE STOCKHOLDERS, PARTNERS OR LLC MEMBERS LISTED IN PART II

If a Bidder has a direct or indirect parent entity which is publicly traded, and any person holds a 10 percent or greater beneficial interest in the publicly traded parent entity as of the last annual federal Security and Exchange Commission (SEC) or foreign equivalent filing, ownership disclosure can be met by providing links to the website(s) containing the last annual filing(s) with the federal Securities and Exchange Commission (or

Website (URL) containing the la	st annual SEC (or foreign equivalent) filing	Page #'s
or any publicly traded parent entities referendedresses of every non-corporate stockholder, a	nd/or limited liability company (LLC) listed in Part nced above . The disclosure shall be continued untind individual partner, and member exceeding the 10.A. 52:25-24.2 has been listed. Attach additional s	l names and) percent
Stockholder/Partner/Member and	Home Address (for Individuals) or Business	Address
Corresponding Entity Listed in Part II		
Corresponding Entity Listed in Part II		
Corresponding Entity Listed in Part II		
Corresponding Entity Listed in Part II		

certification through the completion of any contracts with the District to notify the District in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the, permitting the District to declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print):			Title:			
Signature:			Date:			
Company Representa	ative				Date	

AFFIRMATIVE ACTION COMPLIANCE NOTICE N.J.S.A. 10:5-31 and N.J.A.C. 17:27

GOODS AND SERVICES CONTRACTS (INCLUDING PROFESSIONAL SERVICES)

This form is a summary of the successful Bidder's requirement to comply with the requirements of N.J.S.A. 10:5-31 and N.J.A.C. 17:27-1 et seq.

The successful Bidder shall submit to the public agency, after notification of award but prior to execution of this contract, one of the following three documents as forms of evidence:

(a) A photocopy of a valid letter that the Contractor is operating under an existing Federally approved or sanctioned affirmative action program (good for one year from the date of the letter);

OR

(b) A photocopy of a Certificate of Employee Information Report approval, issued in accordance with N.J.A.C. 17:27-4;

OR

(c) A photocopy of an Employee Information Report (Form AA302) provided by the Division and distributed to the public agency to be completed by the Contractor in accordance with N.J.A.C. 17:27-4.

The successful Contractor may obtain the Affirmative Action Employee Information Report (AA302) from the contracting unit during normal business hours.

The successful Contractor(s) must submit the copies of the AA302 Report to the Division of Contract Compliance and Equal Employment Opportunity in Public Contracts (Division). The Public Agency copy is submitted to the public agency, and the Contractor copy is retained by the Contractor.

The undersigned Contractor certifies that he/she is aware of the commitment to comply with the requirements of N.J.S.A. 10:5-31 and N.J.A.C. 17:27.1 et seq. and agrees to furnish the required forms of evidence.

The undersigned Contractor further understands that his/her bid shall be rejected as non-responsive if said Contractor fails to comply with the requirements of N.J.S.A. 10:5-31 and N.J.A.C. 17:27-1 et seq.

COMPANY:	SIGNATURE:
PRINT NAME:	TITLE:
DATF:	

INSTRUCTIONS FOR COMPLETING THE EMPLOYEE INFORMATION REPORT (FORM AA302)

IMPORTANT: READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE COMPLETING THE FORM. PRINT OR TYPE ALL INFORMATION. FAILURE TO PROPERLY COMPLETE THE ENTIRE FORM AND TO SUBMIT THE REQUIRED \$150.00 NON-REFUNDABLE FEE MAY DELAY ISSUANCE OF YOUR CERTIFICATE. IF YOU HAVE A CURRENT CERTIFICATE OF EMPLOYEE INFORMATION REPORT, DO NOT COMPLETE THIS FORM UNLESS YOUR ARE RENEWING A CERTIFICATE THAT IS DUE FOR EXPIRATION. DO NOT COMPLETE THIS FORM FOR CONSTRUCTION CONTRACT AWARDS.

- ITEM 1 Enter the Federal Identification Number assigned by the Internal Revenue Service, or if a Federal Employer Identification Number has been applied for, or if your business is such that you have not or will not receive a Federal Employer Identification Number, enter the Social Security Number of the owner or of one partner, in the case of a partnership.
- ITEM 2 Check the box appropriate to your TYPE OF BUSINESS. If you are engaged in more than one type of business check the predominate one. If you are a manufacturer deriving more than 50% of your receipts from your own retail outlets, check "Retail".
- **ITEM 3** Enter the total "number" of employees in the entire company, including part-time employees. This number shall include all facilities in the entire firm or corporation.
- **ITEM 4** Enter the name by which the company is identified. If there is more than one company name, enter the predominate one.
- ITEM 5 Enter the physical location of the company. Include City, County, State and Zip Code.
- ITEM 6 Enter the name of any parent or affiliated company including the City, County, State and Zip Code. If there is none, so indicate by entering "None" or N/A.
- ITEM 7 Check the box appropriate to your type of company establishment. "Single-establishment Employer" shall include an employer whose business is conducted at only one physical location. "Multi-establishment Employer" shall include an employer whose business is conducted at more than one location.
- ITEM 8 If "Multi-establishment" was entered in item 8, enter the number of establishments within the State of New Jersey.
- ITEM 9 Enter the total number of employees at the establishment being awarded the contract.
- ITEM 10 Enter the name of the Public Agency awarding the contract. Include City, County, State and Zip Code. This is not applicable if you are renewing a current Certificate.

ITEM 11 - Enter the appropriate figures on all lines and in all columns. THIS SHALL ONLY INCLUDE EMPLOYMENT DATA FROM THE FACILITY THAT IS BEING AWARDED THE CONTRACT. DO NOT list the same employee in more than one job category. **DO NOT attach an EEO-1 Report**.

Racial/Ethnic Groups will be defined:

Black: Not of Hispanic origin. Persons having origin in any of the Black racial groups of Africa.

Hispanic: Persons of Mexican, Puerto Rican, Cuban, or Central or South American or other Spanish culture or origin, regardless of race.

American Indian or Alaskan Native: Persons having origins in any of the original peoples of North America, and who maintain cultural identification through tribal affiliation or community recognition.

Asian or Pacific Islander: Persons having origin in any of the original peoples of the Far East, Southeast Asia, the Indian Sub-continent or the Pacific Islands. This area includes for example, China, Japan, Korea, the Phillippine Islands and Samoa.

Non-Minority: Any Persons not identified in any of the aforementioned Racial/Ethnic Groups.

- ITEM 12 Check the appropriate box. If the race or ethnic group information was not obtained by 1 or 2, specify by what other means this was done in 3.
- **ITEM 13** Enter the dates of the payroll period used to prepare the employment data presented in Item 12.
- ITEM 14 If this is the first time an Employee Information Report has been submitted for this company, check block "Yes".
- ITEM 15 If the answer to Item 14 is "No", enter the date when the last Employee Information Report was submitted by this company.
- ITEM 16 Print or type the name of the person completing the form. Include the signature, title and date.
- ITEM 17 Enter the physical location where the form is being completed. Include City, State, Zip Code and Phone Number.

TYPE OR PRINT IN SHARP BALL POINT PEN

THE VENDOR IS TO COMPLETE THE EMPLOYEE INFORMATION REPORT FORM (AA302) AND RETAIN A COPY FOR THE VENDOR'S OWN FILES. THE VENDOR SHOULD ALSO SUBMIT A COPY TO THE PUBLIC AGENCY AWARDING THE CONTRACT IF THIS IS YOUR FIRST REPORT; AND FORWARD ONE COPY WITH A CHECK IN THE AMOUNT OF \$150.00 PAYABLE TO THE TREASURER, STATE OF NEW JERSEY(FEE IS NON-REFUNDABLE) TO:

NJ Department of the Treasury Division of Purchase & Property Contract Compliance Audit Unit EEO Monitoring Program P.O. Box 206

Trenton, New Jersey 08625-0206

Telephone No. (609) 292-5473

Form AA302 Rev. 02/22

STATE OF NEW JERSEY

Division of Purchase & Property Contract Compliance Audit Unit EEO Monitoring Program

EMPLOYEE INFORMATION REPORT

IMPORTANT-READ INSTRUCTIONS CAREFULLY BEFORE COMPLETING FORM. FAILURE TO PROPERLY COMPLETE THE ENTIRE FORM AND TO SUBMIT THE REQUIRED \$150.00 FEE MAY DELAY ISSUANCE OF YOUR CERTIFICATE. DO NOT SUBMIT EEO-1 REPORT FOR SECTION B, ITEM 11. For Instructions on completing the form, go to: https://www.nj.gov/treasury/contract_compliance/documents/pdf/forms/aa302ins.pdf

_					SECTION	ON A - CO	MPANY	IDENT	TIFICATI	ON					
1. FID. NO. OR	SOCIAL S	ECURITY		2. TYPE OF BUSINESS 1. MFG 2. SERVICE 3. WHOLESALE COMPANY 3. TOTAL NO. EMPLOYEES IN THE ENTIRE COMPANY					RE						
4. COMPANY N	IAME								cor	MPANY E	-MAIL				_
5. STREET				CI	ГҮ		COU	NTY	ST	TATE	ZI	PCODE			_
6. NAME OF PA	ARENT OI	R AFFILL	ATED COM	MPANY (I	f none, so	INDICATE	Ξ)	CI	TY	S	TATE	Z	IP CODE		
7. CHECK ONE	: IS THE C	COMPANY	r. 🗆	SINGLE	-ESTABLISF	IMENT EM	PLOYER		□м	ULTI-EST	TABLISHMI	ENT EMPI	LOYER		
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17. ADDRESS	NO, & ST	REET	CI	ΓY		COU	NTY	ST	ATE 2	IP CODE	PHONE (AREA CO	de, no.,e	 XTENSI	ON)

EXHIBIT A

MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE N.J.S.A. 10:5-31 et seq. (P.L. 1975, c. 127) N.J.A.C. 17:27et seq.

GOODS, GENERAL SERVICES, AND PROFESSIONAL CONTRACTS

During the performance of this contract, the Contractor agrees as follows:

The Contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the Contractor will ensure that equal employment opportunity is afforded to such applicants in recruitment and employment, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such equal employment opportunity shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

The Contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex.

The Contractor or subcontractor will send to each labor union, with which it has a collective bargaining agreement, a notice, to be provided by the agency contracting officer, advising the labor union of the Contractor's commitments under this chapter and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The Contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act.

The Contractor or subcontractor agrees to make good faith efforts to meet targeted county employment goals established in accordance with N.J.A.C. I7:27-5.2

EXHIBIT A (Cont)

The Contractor or subcontractor agrees to inform in writing its appropriate recruitment agencies including, but not limited to, employment agencies, placement bureaus, colleges, universities, and labor unions, that it does not discriminate on the basis of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex, and that it will discontinue the use of any recruitment agency which engages in direct or indirect discriminatory practices.

The Contractor or subcontractor agrees to revise any of its testing procedures, if necessary, to assure that all personnel testing conforms with the principles of job related testing, as established by the statutes and court decisions of the State of New Jersey and as established by applicable Federal law and applicable Federal court decisions.

In conforming with the targeted employment goals, the Contractor or subcontractor agrees to review all procedures relating to transfer, upgrading, downgrading and layoff to ensure that all such actions are taken without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex, consistent with the statutes and court decisions of the State of New Jersey, and applicable Federal law and applicable Federal court decisions.

The Contractor shall submit to the public agency, after notification of award but prior to execution of a goods and services contract, one of the following three documents:

Letter of Federal Affirmative Action Plan Approval;

Certificate of Employee Information Report; or

Employee Information Report Form AA-302 (electronically provided by the Division and distributed to the public agency through the Division's website at: http://www.state.nj.us/treasury/contract_compliance.

The Contractor and its subcontractors shall furnish such reports or other documents to the Division of Purchase & Property, CCAU, EEO Monitoring Program as may be requested by the office from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Division of Purchase & Property, CCAU, EEO Monitoring Program for conducting a compliance investigation pursuant to N.J.A.C. 17:27-1.1 et seq.

COMPANY:	SIGNATURE:
PRINT NAME:	TITLE:
DATE:	

NON-COLLUSION AFFIDAVIT

		Title of Bid and Bid	Number				
l,		of the City o	f				
in the County of		and the State of					
of full age, being duly swo	rn according to law o	n my oath depose say tl	nat:				
I am		_of the Firm of					
Bidder has not directly or restraint of free, competit this affidavit are true and	indirectly, entered in live bidding in connect correct, and made wi	nto any agreement, par tion with the above nar th full knowledge that	ticipated in any collus ned bid, and that all st :he Public School Distr	d with full authority so to do that said ion, or otherwise taken any action in atements contained in said bid and in ict of the City of Paterson relies upon davit in awarding the contract for the			
	ing for a commission,	percentage, brokerage		icit or secure such contract upon an ept bona fide employees of bona fide			
		Print Name of Cor	tractor				
Subscribed and sworn to:		of Contractor		_			
Before me this	day of	Month	Year				
Print name of N	Notary Public	_					
Notary Public	Signature	_					
My commission expires _	 Month	Day	Seal Year				
		•					
Company Repre	sentative			Date			

COMPANY INFORMATION FORM

Company Name:			
Address:			
Address:			
City:		State:	Zip:
Tax ID No.:	(Required)	NJ BRC Number:	(Required
Telephone :		Fax:	
Website:		Email:	
*The information provided DISCLAIMER	will be used for statistical purposes onl	ly. This information will not be ι	ised to select the winning bid
CONFIRMATION OF S	PECIFICATIONS		
I have read and understoners.	od the written specifications required by (y/n)	y this bid and agree to all aspe	cts of the information provided
DEBARTMENT, SUSP	ENSION OR DISQUALIFICATION		
	l on the State Treasurer's List of Debarr Debarment List? (y/i		Bidders or the State Department
If yes, explain:			
NON-COLLUSION STA	ATEMENT		
Has your company been i discuss this bid?	n contact with any District employee or (y/n)	elected official, other than the	Purchasing Department to
If yes, explain:			
POLITICAL CONTRIB	UTIONS		
	contribution(s) that exceeded \$300.00 ttees during the 12 months prior to aw	-	_
If yes, complete attached	d form.		
Name of Officer Authorize	d to Submit Bid:		
Print Name:		Position:	
Signature:		Date:	
Company Representa	ative		Date

Form W-9 (Rev. March 2024) Department of the Treasury Internal Revenue Service

Request for Taxpayer Identification Number and Certification

Go to www.irs.gov/FormW9 for instructions and the latest information.

Give form to the requester. Do not send to the IRS.

Deloi	Name of entity/individual. An entry is required. (For a sole proprietor or disregarded entity's name on line 2.)	C=07000M - 5000 FF (
	Business name/disregarded entity name, if different from above.	
Print or type. See Specific Instructions on page 3.	3a Check the appropriate box for federal tax classification of the entity/individual who only one of the following seven boxes. Individual/sole proprietor C corporation S corporation, P = Pal Note: Check the "LLC" box above and, in the entry space, enter the appropriat classification of the LLC, unless it is a disregarded entity. A disregarded entity sbox for the tax classification of its owner. Other (see instructions)	certain entities, not individuals; see instructions on page 3): Partnership
Specific	3b If on line 3a you checked "Partnership" or "Trust/estate," or checked "LLC" and en and you are providing this form to a partnership, trust, or estate in which you ha this box if you have any foreign partners, owners, or beneficiaries. See instructions	ave an ownership interest, check (Applies to accounts maintained
See	5 Address (number, street, and apt. or suite no.). See instructions.	Requester's name and address (optional)
	6 City, state, and ZIP code	
	7 List account number(s) here (optional)	1
Par	Taxpayer Identification Number (TIN)	
backu reside	your TIN in the appropriate box. The TIN provided must match the name give up withholding. For individuals, this is generally your social security number (sent alien, sole proprietor, or disregarded entity, see the instructions for Part I, es, it is your employer identification number (EIN). If you do not have a number	SSN). However, for a later. For other
TIN, la		· ur
	If the account is in more than one name, see the instructions for line 1. See a per To Give the Requester for guidelines on whose number to enter.	also What Name and – – – – – – – – – – – – – – – – – – –
Par	t II Certification	
Unde	r penalties of perjury, I certify that:	
2. I ar Ser	e number shown on this form is my correct taxpayer identification number (or n not subject to backup withholding because (a) I am exempt from backup w rvice (IRS) that I am subject to backup withholding as a result of a failure to re longer subject to backup withholding; and	ithholding, or (b) I have not been notified by the Internal Revenue
3. I ar	n a U.S. citizen or other U.S. person (defined below); and	
4. The	e FATCA code(s) entered on this form (if any) indicating that I am exempt from	n FATCA reporting is correct.
becau acquis	ication instructions. You must cross out item 2 above if you have been notified use you have failed to report all interest and dividends on your tax return. For real sition or abandonment of secured property, cancellation of debt, contributions to than interest and dividends, you are not required to sign the certification, but you	I estate transactions, item 2 does not apply. For mortgage interest paid or an individual retirement arrangement (IRA), and, generally, payments
Sign		Date
	requ	lew line 3b has been added to this form. A flow-through entity is uired to complete this line to indicate that it has direct or indirect birgh partners, owners, or beneficiaries when it provides the Form W-5

Section references are to the Internal Revenue Code unless otherwise

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to www.irs.gov/FormW9.

What's New

Line 3a has been modified to clarify how a disregarded entity completes this line. An LLC that is a disregarded entity should check the appropriate box for the tax classification of its owner. Otherwise, it should check the "LLC" box and enter its appropriate tax classification.

New line 3b has been added to this form. A flow-through entity is required to complete this line to indicate that it has direct or indirect foreign partners, owners, or beneficiaries when it provides the Form W-9 to another flow-through entity in which it has an ownership interest. This change is intended to provide a flow-through entity with information regarding the status of its indirect foreign partners, owners, or beneficiaries, so that it can satisfy any applicable reporting requirements. For example, a partnership that has any indirect foreign partners may be required to complete Schedules K-2 and K-3. See the Partnership Instructions for Schedules K-2 and K-3 (Form 1065).

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS is giving you this form because they

Cat. No. 10231X Form **W-9** (Rev. 3-2024)

REFERENCE SHEET

Names and Addresses of Three (3) References

Company Name:				
Address:				
City:		Stat	e:	Zip:
Telephone: ()	-		Fax: ()	-
Contact Person :		Email	:	
Company Name:				
Address:				
City:		Stat	e:	Zip:
Telephone: ()	-	•	Fax: ()	-
Contact Person :		Ema	il:	
Company Name:				
Address:				
City:		Stat	e:	Zip:
Telephone: ()	-	•	Fax: ()	-
Contact Person :		Ema	il:	
able in whole or in part ipment, work or services	o member of the Paterson Board of Ed by said Board of Education is directly s to which it relates, or in any portion o and has an interest in the bid, etc. then p or company.	or inc	lirectly interested in ts thereof. If a situation	n this bid or in the supplies, materials ation so exists where a Board member
sident:		Signat	ture:	
Company Repres				 Date

EQUIPMENT/ PREVAILING WAGE/UNAUTHORIZED ORDERS CERTIFICATION

The undersigned Bidder hereby certifies as follows:

- The Bidder owns or controls all the necessary equipment required to deliver the goods and/or services described in the specifications.
- If required, the Bidder has the necessary license(s) pursuant to local and state regulations to provide the services under this bid.
- The Bidder will comply with The New Jersey Prevailing Wage Act (N.J.S.A. 34:11-56.25 et seq.)
- The Bidder will not process or respond to any request or provide any type of service without a signed Purchase Order.
- The Bidder will not exceed the amount of the approved Purchase Order.
- The Bidder will report any unauthorized request for services without a valid PO
- If no award is made after 60 days, Bidder agrees to maintain the bid price effectively for an additional 60 days.
- The Bidder will comply with all Affirmative Action Requirements
- The Bidder will comply with the Americans with Disabilities Act of 1990
- If shipping charges are wrongly applied the Contractor shall not process the order and/or shall reimburse the District
- If wrong prices are applied by the District or if discount is not applied, Contractor shall not process the order and/or shall reimburse the District.
- The company has not made any contribution(s) (that exceed \$300 per election cycle) that were made during the 12 months prior to the award of the contract.

Bid #	Name of Bidder:		
By:(Signature)			
Name of above:	(Print)		
Title:		Date:	 -
Company Representative	_		 Date

C. 271 POLITICAL CONTRIBUTION DISCLOSURE FORM

Required Pursuant To N.J.S.A. 19:44A-20.26

	Part I – Contractor Information	1	
Contractor Name:			
Address:			
City:	State: Zip:		
the provisions of N.J.S.A. 19:44A	certify, hereby certifies that the submiss -20.26 and as represented by the Instru	uctions accompanying th	nis form.
Signature	Printed Name	Title	
art II – Contribution Disclosure			
	to <u>N.J.S.A.</u> 19:44A-20.26, this disclection cycle) made during the 12 month		
Contributor Name	Recipient Name	Date	Dollar Amou
			\$

Disclosure of Investment Activities in Iran						
Person or Entity						
	Part 1: Certification					
proposes to enter into perjury, that neither the State Department of The list is found on The Chapter 25 list mis found to be in violate contract, including be	complete Part 1 By Checking Either Box . w 2012, c. 25, any person or entity that is a successful bidder or proposer, or otherwise or renew a contract, must complete the certification below to attest, under penalty of the person or entity, nor any parent entity, subsidiary, or affiliate is identified on the reasury's Chapter 25 list as a person or entity engaging in investment activities in Iran. The reasury's website at www.state.nj.us/treasury/purchase/pdf/Chapter25List.pdf . The reviewed prior to completing the below certification. If a vendor or contractor attion of law, action may be taken as appropriate and as may provided by law, rule or ut not limited to imposing sanctions, seeking compliance, recovering damages, default and seeking debarment or suspension of the party.					
	I certify, pursuant to Public Law 2012, c. 25, that neither the person or entity listed above, nor any parent entity, subsidiary, or affiliate thereof is listed on the N.J. Department of the Treasury's list of entities determined to be engaged in prohibited activities in Iran pursuant to P.L. 2012, c. 25 ("Chapter 25 List"). I further certify that I am the person listed above, or I am an officer or representative of the entity listed above and am authorized to make this certification on its behalf. I will skip Part 2 and sign and complete the Certification below.					
	OR					
	I am unable to certify as above because the person or entity and/or a parent entity, subsidiary, or affiliate thereof is listed on the N.J. Department of the Treasury's Chapter 25 list. I will provide a detailed, accurate and precise description of the activities in Part 2 below sign and complete the Certification below.					

	Part 2: Additional Inf	forma	tion	
PLEASE PRIRAN.	OVIDE FURTHER INFORMATION RELA	TED 7	TO INV	ESTMENT ACTIVITIES IN
You must proparent entity,	ovide a detailed, accurate and precise description subsidiary, or affiliate thereof engaging in inved, on additional sheets provided by you.			1
	Part 3: Certification of True and (Comp	lete In	formation
any attachn	g duly sworn upon my oath, hereby represent an nents there to the best of my knowledge are true his certification on behalf of the above-referenc	e and c	omplete.	I attest that I am authorized
and thereby through the	wledge that the Name of Contracting Unit is reaction acknowledge that I am under a continuing of completion of any contracts with the Reference ing Unit in writing of any changes to the answer.	bligati to Con	on from ntracting	the date of this certification g Unit to notify the Reference
misrepreser prosecution the Name o	owledge that I am aware that it is a criminatation in this certification, and if I do so, I wanter the law and that it will also constitute of Contracting Unit and that the Reference to (et(s)) resulting from this certification void and un	I recos a mate Contra	gnize the erial bre acting U	at I am subject to criminal ach of my agreement(s) with
Full Name (Print)	ר	Title		
Signature	•		Date	

CERTIFICATION OF NON-INVOLVEMENT IN PROHIBITED ACTIVITIES IN RUSSIA OR BELARUS

PATERSON BOARD OF EDUCATION

N.J.S.A. 18A:18A-49.5

Pursuant to N.J.S.A. 52:32-60.1, et seq. (<u>L. 2022, c. 3</u>) any person or entity (hereinafter "Vendorⁱ") that seeks to enter into or renew a contract with a State agency for the provision of goods or services, or the purchase of bonds or other obligations, must complete the certification below indicating whether or not the Vendor is identified on the Office of Foreign Assets Control (OFAC) Specially Designated Nationals and Blocked Persons list, available here: https://sanctionssearch.ofac.treas.gov/. If the Department of the Treasury finds that a Vendor has made a certification in violation of the law, it shall take any action as may be appropriate and provided by law, rule, or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the party.

I, the undersigned, certify that I have read the definition of "Vendor" below, and have reviewed the Office of Foreign Assets Control (OFAC) Specially Designated Nationals and Blocked Persons list, and having done so certify:

(Check the Appropriate Box)

0	A.	That the Vendor is not identified on the <u>OFAC Specially Designated Nationals and Blocked Persons list on account of activity related to Russia and/or Belarus</u> .		
		OR		
0	В.		ecause the Vendor is identified on the OFAC Specially account of activity related to Russia and/or Belarus.	
		OR		
0	C.	Designated Nationals and Blocked Persons list. He and/or Belarus consistent with federal law, regular	ecause the Vendor is identified on the OFAC Specially owever, the Vendor is engaged in activity related to Russia ation, license or exemption. A detailed description of how arus is consistent with federal law is set forth below.	
			(Attach Additional Sheets If Necessary.)	
Signa	ture of	Vendor's Authorized Representative	Date	
Print I	Name a	and Title of Vendor's Authorized Representative	Vendor's FEIN	
Vende	or's Naı	me	Vendor's Phone Number	
Vende	or's Ad	dress (Street Address)	Vendor's Fax Number	
Vend	or's Ada	dress (City/State/7in Code)	Vendor's Email Address	

i Vendor means: (1) A natural person, corporation, company, limited partnership, limited liability partnership, limited liability company, business association, sole proprietorship, joint venture, partnership, society, trust, or any other nongovernmental entity, organization, or group; (2) Any governmental entity or instrumentality of a government, including a multilateral development institution, as defined in Section 1701(c)(3) of the International Financial Institutions Act, 22 U.S.C. 262r(c)(3); or (3) Any parent, successor, subunit, direct or indirect subsidiary, or any entity under common ownership or control with, any entity described in paragraph (1) or (2). NJ Rev. 1.22.2024

ACKNOWLEDGEMENT OF RECEIPT OF ADDENDA

THE UNDERSIGNED BIDDER HEREBY ACKNOWLEDGES RECEIPT OF THE FOLLOWING ADDENDA:

ADDENDUM #	DATE	
ADDENDUM #	DATE	
ADDENDUM #	DATE	
NO ADDENDUM WAS ISSUED FOR THIS BID:	(check if no addendum was issued)	
BY: (PRINT OR TYPE NAME)	(TITLE)	-
(SIGNAT	rure)	_
COMPANY:		
		
Company Representative		Date

BID PROPOSAL PRICING/COMPLIANCE FORM

The undersigned does declare that they have carefully and completely examined the specifications, together with the advertisement, instructions to bidders, bond agreements, as well as the premises and all laws, ordinances and regulations governing the work and all other documents attached hereto and fully understand the meaning of all of them and if awarded the contract, hereby agree that they will comply with all of the terms, covenants, and agreement set forth therein.

(Contract Title	e and Bid Number, if applicable)			
(Description	n of goods/services being bid)			
The undersigned proposes to furnish and deliver the above goods/services pursuant to the bid specification and made part hereof:				
Company Name	Federal I.D. # or Social Security #			
Address				
Signature of Authorized Agent	Type or Print Name			
Title:	_			
Telephone Number	Date			
E-mail address				

PROJECT MANUAL AND SPECIFICATIONS

FOR

PATERSON PUBLIC SCHOOLS PATERSON, NEW JERSEY



First and Second Floor Girls & Boys Bathroom Renovations for: Eastside High School 150 Park Avenue, Paterson, NJ 07501 Block:4101 Lot:6



CMA PROJECT NO. 23072

February 7th, 2025

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- 017320 Selective Demolition

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FORM OF PROPOSAL

PROJECT: First and Second Floor Girls and Boys Bathroom Renovations for: Eastside

HighSchool- Paterson Public Schools

150 Park Avenue, Paterson, NJ 07501, Block: 4101 Lot :6

OWNER: PATERSON PUBLIC SCHOOLS

90 DELAWARE AVENUE

PATERSON, NEW JERSEY 07503

Gentlemen:

General Conditions

The Undersigned hereby proposes to furnish all materials and do all the labor necessary to execute all of the work for the **First and Second Floor Girls and Boys Bathroom Renovations for: Eastside HighSchool** located in Paterson, NJ., as shown on the drawings and described in the specifications prepared by Coppa Montalbano Architects, P.C., 97 Lackawanna Avenue, Totowa, NJ 07512

CONTRACT NO. 1, SINGLE PRIME BID:

BASE BID – SINGLE PRIME BID FOR ALL WORK

For <u>ALL WORK, LABOR, MATERIALS & INSTALLATION</u> for the above referenced contract name, including, all site work as indicated on drawings and in specifications, allowance as described in the drawings and specifications and all Bid Documents a **BASE BID**, for the above mentioned contract, of:

	Dollars (\$)
TOTAL BASE BID:		
Refer to Specification Section 012100 "Allowances" for description	ns and requirements	
ALLOWANCES: Refer to Specification Section 012100 "Allow alternate descriptions and requirements.	ances" for specific	
Allowance #1 "Unforeseen Conditions" (To be included in base	e bid)*	24,000.00
All other work	\$	
Electrical	\$	
Fire Alarm	\$	
Plumbing	\$	
HVAC/Mechanical	\$	
Specialties	\$	
Finishes	\$	
Doors, Windows, Glass	\$	
Thermal and Moisture Protection	\$	
Woods and Plastics	\$	
Metals	\$	
Masonry	\$	-
Concrete	\$	
Site Work	\$	

P003 - 1 of 5 2/7/2025

CONTRACT No. & NAME: (Bidder Fill In)	
CONTRACT TITLE: (Bidder Fill In)	
DATE OF BID: (Bidder Fill In)	
PROJECT: Renovations for:	First and Second Floor Girls and Boys Bathroom Eastside HighSchool- Paterson Public Schools 150 Park Avenue, Paterson, NJ 07501, Block: 4101 Lot :6
SUBMITTED BY: (Name/Address of Bidder)	
telephone # Person to contact	()

(BIDDER SHALL COMPLETE APPROPRIATE SPACES FOR CONTRACT HE IS BIDDING ON)

<u>The Bidder</u> 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 complete all work as specified or indicated in the Contract documents for the Contract Price and within the Contract time indicated in this bid and in accordance with the Contract Documents.

<u>Bidder</u> accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid Security. This Bid shall remain applicable for sixty (60) calendar days after the day of Bid opening. Bidder shall sign the Agreement and submit the Contract Security and other documents required by the Contract Documents within the time period so specified after the date of Owner's Notice of Award.

ADDENDA:

In submitting this Bid, Bidder represents, as more fully set forth in the Agreement, that:

<u>Bidder</u> has examined the site and locality where the Work is to be performed, the legal requirements (federal, state and local laws, ordinances, rules and regulations) and the conditions affecting cost, progress or performance of the Work and has made such independent investigations as Bidder deems necessary.

<u>This Bid</u> is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly included or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or a corporation to refrain from bidding, and Bidder has not sought by collusion to obtain for himself any advantage over any other Bidder or over Owner.

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Clarification:	opies of all Contract Documents and of the following Addenda and Letters of
<u>Addenda No.</u>	Addenda Date Letter of Clarification. LOC Date
CONTRACT TIME LIMIT	OF COMPLETION:
Bidder agrees that the wo	ork shall be substantially completed within 60 calendar days from the written
The bidder agrees to perfoto Proceed.	orm the work of by the Time of Completion offrom Written Notice
LIQUIDATED DAMAGES	<u>u</u>
	and every calendar day the work or any portion thereof remains incomplete, after tion, liquidated damages in the amount of two-hundred fifty (\$250.00) dollars per cted from the monies due.
UNIT PRICES:	
None	
SUBCONTRACTORS:	
SUBCONTRACTOR SUBCONTRACTOR	Name and address of Subcontractor
	Name and address of Subcontractor
SUBCONTRACTOR GENERAL	Name and address of Subcontractor
SUBCONTRACTOR GENERAL CONSTRUCTION	Name and address of Subcontractor
SUBCONTRACTOR GENERAL CONSTRUCTION PLUMBING	Name and address of Subcontractor
SUBCONTRACTOR GENERAL CONSTRUCTION PLUMBING HVAC	Name and address of Subcontractor
SUBCONTRACTOR GENERAL CONSTRUCTION PLUMBING HVAC ELECTRICAL SIGNATURE: The terms used in this B	Bid, which are defined in the General Conditions of the construction Contract and cluded as part of the Contract Documents, have the meanings assigned to them in
SUBCONTRACTOR GENERAL CONSTRUCTION PLUMBING HVAC ELECTRICAL SIGNATURE: The terms used in this B Instructions to Bidders ince	Bid, which are defined in the General Conditions of the construction Contract and cluded as part of the Contract Documents, have the meanings assigned to them in
SUBCONTRACTOR GENERAL CONSTRUCTION PLUMBING HVAC ELECTRICAL SIGNATURE: The terms used in this B Instructions to Bidders ince the General Conditions an An Individual: By	Bid, which are defined in the General Conditions of the construction Contract and cluded as part of the Contract Documents, have the meanings assigned to them in

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Doing Business As:	_		
Business Address:			
	•		
Telephone Number:	()		
rolophono rtambor.	,		
A Partnership:			
By			(SEAL)
(Firm Name	e)		_(02/12)
(General Partne	er, Type 8	& Signature)	
Business Address:			
Dusiness Address.			
-			
_			
Telephone No : (1		
relephone No (/		
A Corporation:			
Ву			(SEAL)
(Corpora	ation Nam	ne)	,
(State of Ir	ncorporat	ion)	
Ву			
(Name of person a	uthorized	to sign, Type & Signature)	
(Title)			
Corporate Seal			
Attest:			
	, Type &	Signature)	
Business Address:			
Dusilless Address			
_			
Telephone No.: ()			
A Joint Venture:			
Ву			
(Name, T	ype & Sig	gnature)	
(Addre	ess)		

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Ву			
(Name, Type & Signature)			
(Address)			
(Each joint venturer must sign. The mar a party to the joint venture should be in t		lual, partnership, and c	orporation that is
CONTRACT:			
If written notice of the acceptance of thi days after date of the opening of bids, texecute a standard agreement.			
The undersigned designates as the addelivered:	ddress to which the above r	notice may be mailed	, telegraphed, or
Name:			
Address:(Street)	(City)	(State)	(Zip)
Telephone No			
Respectfully submitted,			
Signed		_	
*(Insert)			
Dated			
Under the space provided for after sign Corporation, indicate the State of Incorp			
Laws of the State of	" If a partnership, indicor trade name, indicate the indicer the firm name of "	cate the names of the dividual's name and a	partners and the dd the"
END OF SECTION			

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SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
 - Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - Testing & Inspection (To Be included in base bid)
 - 2. Unforeseen Conditions (To Be included in base bid)

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.4 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

ALLOWANCES 012100 Page 1 of 2

1.7 TESTING AND INSPECTING ALLOWANCES

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.8 UNUSED MATERIALS

- A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - If requested by Architect, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Architect, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

<u>Allowance #1 - "Unforeseen Conditions"</u> Include the sum of \$24,000 in the base bid for unforeseen Work in the Project. This will be considered a contingency allowance, as described in paragraph 1.7, Contingency Allowances, in this section. This allowance is for work required outside of the work described in the contract documents.

END OF SECTION 012100

ALLOWANCES 012100 Page 2 of 2

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
- B. Each sub-contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific sub-contractor.
- C. Related Sections include the following:
 - 1. Division 1 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
 - 2. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
 - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate sub-contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's Construction Schedule.
 - 2. Preparation of the Schedule of Values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.

- 7. Project closeout activities.
- 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.4 SUBMITTALS

- A. Key Personnel Names: Within 2 days of Notice to Proceed, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
 - 1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
 - 1. Include special personnel required for coordination of operations with other contractors.

1.6 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting, coordinate with Architect. Notify Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Progress Meetings: Conduct progress meetings at weekly intervals, unless/until Architect notifies otherwise. Coordinate dates of meetings with preparation of payment requests.
 - Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.

- 3) Status of submittals.
- 4) Deliveries.
- 5) Off-site fabrication.
- 6) Access.
- 7) Site utilization.
- 8) Temporary facilities and controls.
- 9) Work hours.
- 10) Hazards and risks.
- 11) Progress cleaning.
- 12) Quality and work standards.
- 13) Status of correction of deficient items.
- 14) Field observations.
- 15) Requests for interpretations (RFIs).
- 16) Status of proposal requests.
- 17) Pending changes.
- 18) Status of Change Orders.
- 19) Pending claims and disputes.
- 20) Documentation of information for payment requests.
- 3. Minutes: General Contractor to Record and distribute meeting minutes within three days of the meeting.
 - a. Include a brief summary, in narrative form, of progress since the previous meeting and report.
 - b. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present
 - c. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.7 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified *to the Construction Manager*.
 - 1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
 - Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Contractor.
 - 4. Name of Architect and Construction Manager.
 - RFI number, numbered sequentially.
 - 6. Specification Section number and title and related paragraphs, as appropriate.
 - 7. Drawing number and detail references, as appropriate.
 - 8. Field dimensions and conditions, as appropriate.
 - 9. Contractor's suggested solution(s).
 - 10. If a response to an RFI may impact the Contract Time or the Contract Sum, Contractor shall state potential impacts in the RFI to facilitate the Construction Manager/Architect in formulating their response. Any delays in response due to contractor's failure to clearly identify potential cost and/or time impacts will be borne by the contractor.
 - 11. Contractor's signature.
 - 12. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

- a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- 13. Any delays in response due to contractor's failure to provide the required items listed above will be borne by the contractor.
- C. Hard-Copy RFIs:
 - Identify each page of attachments with the RFI number and sequential page number.
- D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and return it. Allow <u>ten</u> working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
 - 1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
 - 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 - 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 10 days of receipt of the RFI response.
- E. On receipt of Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within seven days if Contractor disagrees with response.
- F. 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 and Construction Manager.
 - 4. RFI number including RFIs that were dropped and not submitted.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's and Construction Manager's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Preliminary Construction Schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Submittals Schedule.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Field condition reports.
 - 7. Special reports.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.
- C. 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.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. 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.
- G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- H. Major Area: A story of construction, a separate building, or a similar significant construction element.

- I. Milestone: A key or critical point in time for reference or measurement.
- J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
- K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

- A. Qualification Data: For scheduling consultant.
- B. Preliminary Construction Schedule: Submit three opaque copies.
 - Approval of cost-loaded preliminary construction schedule will not constitute approval of Schedule of Values for cost-loaded activities.
- C. Contractor's Construction Schedule: Submit three opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
- D. Field Condition Reports: Submit three copies at time of discovery of differing conditions.
- E. Special Reports: Submit three copies at time of unusual event.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

1.6 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports. Refer to Division 1 Project Management and Coordination for requirements.
 - 1. Secure time commitments for performing critical elements of the Work from parties involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established from 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 story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.

- 4. Startup and Testing Time: Include not less than 14 days for each structure for startup and testing.
- 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragments to demonstrate the effect of the proposed change on the overall project schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 7 days after date established for commencement of the Work.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 - 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 3. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.
- C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
 - Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - Testing and commissioning.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 - 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 - 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- D. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Principal events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.

- 6. Early and late finish dates.
- 7. Activity duration in workdays.
- 8. Total float or slack time.
- 9. Average size of workforce.
- 10. Dollar value of activity (coordinated with the Schedule of Values).
- E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.
- F. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 - 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 - In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 - 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 - 4. Prepare list for ease of comparison with payment requests, coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.3 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. Count of personnel at Project site.
 - 3. Equipment at Project site.
 - 4. Material deliveries.
 - 5. High and low temperatures and general weather conditions.
 - 6. Accidents.
 - Meetings and significant decisions.
 - 8. Unusual events (refer to special reports).
 - 9. Stoppages, delays, shortages, and losses.
 - Meter readings and similar recordings.
 - 11. Emergency procedures.
 - 12. Orders and requests of authorities having jurisdiction.
 - 13. Change Orders received and implemented.
 - 14. Work Change Directives received and implemented.
 - 15. Services connected and disconnected.
 - 16. Equipment or system tests and startups.
 - 17. Partial Completions and occupancies.
 - 18. Substantial Completions authorized.
- B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect and Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and quality assurance submittals.
- B. Administrative Submittals: Refer to other Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:
 - 1. Permits.
 - 2. Applications for Payment.
 - 3. Performance and payment bonds.
 - 4. Insurance certificates.
 - List of subcontractors.
 - 6. Building Inspection Reports and Approvals
 - 7. Fire Department Inspection Reports and Approvals
 - 8. Department of Environmental Protection Inspection Reports and Approvals

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action. Submittals may be rejected for not complying with requirements.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.
- C. Coordination Drawings show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or to function as intended. Preparation of Coordination Drawings is specified in Division 1 Section "Coordination" and may include components previously shown in detail on Shop Drawings or Product Data.

1.4 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings may or may not be provided by Architect for Contractor's use in preparing submittals at Architect's discretion.
- 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.
- C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 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.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 - 4. Concurrent Consultant Review: When a submittal requires review by a consultant, the General Contractor is to directly send the reproducible and one print to the consultant. The Architect shall be copied and delivered one print of submittal at the same time. Allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to General Contractor.
- E. Identification: Place a permanent label or title block on each submittal for identification.
 - 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 - 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 - 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - I. Other necessary identification.
- F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- G. Additional 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.
 - Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
 - 2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect **will** discard submittals received from sources other than Contractor.
 - 1. Transmittal Form: Use AIA Document G810.
 - 2. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).

- e. Names of subcontractor, manufacturer, and supplier.
- f. Category and type of submittal.
- g. Submittal purpose and description.
- h. Specification Section number and title.
- i. Drawing number and detail references, as appropriate.
- j. Transmittal number numbered consecutively.
- k. Submittal and transmittal distribution record.
- Remarks.
- m. Signature of transmitter.
- 3. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect **on** previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked "NO EXCEPTION TAKEN".
- J. 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.
- K. Use for Construction: Use only final submittals with mark indicating "NO EXCEPTION TAKEN," by Architect.

1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

 General: At Contractor's written request, copies of Architect's CAD files may be provided, at the Architect's discretion, to Contractor for Contractor's use, with restrictions, in connection with Project.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
 - 1. Submit electronic submittals directly to extranet specifically established for Project.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's printed recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operation and maintenance manuals.
 - k. Compliance with specified referenced standards.
 - I. Testing by recognized testing agency.
 - m. Application of testing agency labels and seals.

- n. Notation of dimensions verified by field measurement
- o. Notation of coordination requirements.
- 4. Submit Product Data before or concurrent with Samples.
- 5. Number of Copies: Submit six copies of Product Data, unless otherwise indicated. Architect will return three copies. Mark up and retain one returned copy as a Project Record Document.
- 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. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Copied Contract Documents and standard information does not satisfy the requirement for Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing. Coordination with adjacent surrounding and back-up material is the responsibility of the General Contractor. Show related work on the shop drawings, identify who will be responsible for supplying and installing it and provide extra copies of the shop drawings showing this work.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products and materials included be sheet and detail number.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - I. Notation of dimensions established by field measurement.
 - m. Relationship to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.
 - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 36 by 48 inches.
 - 3. Number of Copies:
 - a. Initial Submittal: Submit one correctable, translucent, reproducible print and one blueor black-line print for the Architect's review. The Architect will return the reproducible print.
 - When a submittal requires review by a consultant, the General Contractor is to directly send the reproducible and one print to the consultant. The Architect shall be copied and delivered one print of submittal at the same time. Submittal will be returned to Architect before being returned to General Contractor
 - b. Final Submittal: Submit 3 blue- or black-line prints; submit 5 prints where required for maintenance manuals. The Architect will retain 2 prints and return the remainder. One of the prints returned shall be marked up and maintained as a "Record Document".
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.

- d. Number and title of appropriate Specification Section or Drawing Title and number.
- 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - 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.
- 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - 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) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product.
 - 2. Number and name of room or space.
 - 3. Location within room or space.
 - 4. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
 - a. Mark up and retain one returned copy as a Project Record Document.
- F. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation" for Construction Manager's and/or Owner's action.
- G. Submittals Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."
- H. Application for Payment: Comply with requirements specified in Division 1 Section "Payment Procedures."
- I. Schedule of Values: Comply with requirements specified in Division 1 Section "Payment Procedures."
- J. 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. Use CSI Form 1.5A. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

- 4. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
 - a. Mark up and retain one returned copy as a Project Record Document.

2.2 ADMINISTRATIVE SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit three copies of each submittal, unless otherwise indicated. Architect will not return copies.
 - Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - 3. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.

- 4. Product and manufacturers' names.
- 5. Description of product.
- 6. Test procedures and results.
- 7. Limitations of use.
- M. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."
- N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 1 Section "Operation and Maintenance Data."
- R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerances.
 - 3. Sequence of installation or erection.
 - 4. Required installation tolerances.
 - 5. Required adjustments.
 - 6. Recommendations for cleaning and protection.
- T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products, and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.

- U. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.
 - 1. Architect will not review submittals that include MSDSs and will return them for resubmittal.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Stamp: The Architect will stamp each submittal with a uniform, action stamp. The Architect will mark the stamp appropriately to indicate the action taken, as follows:
 - 1. Final Unrestricted Release: When the Architect marks a submittal "NO EXCEPTION TAKEN," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
 - Final-But-Restricted Release: When the Architect marks a submittal "MAKE CORRECTIONS NOTED," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance. A submittal with this action shall be corrected and resubmitted for record copy.
 - 3. Returned for Resubmittal: When the Architect marks a submittal "REJECTED, REVISE AND RESUBMIT", do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
 - 4. Do not use, or allow others to use, submittals marked "REJECTED, REVISE AND RESUBMIT" at the Project Site or elsewhere where Work is in progress.
 - 5. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the Architect will return the submittal marked "Reviewed" or "Action Not Required."
- C. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Unsolicited Submittals: The Architect will return unsolicited submittals to the sender without action.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Quality-control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by Architect
- C. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect and Owner or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.
- I. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

- A. Qualification Data: 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.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.
 - 4. Identification of test and inspection methods.
 - 5. Number of tests and inspections required.
 - 6. Time schedule or time span for tests and inspections.
 - 7. Entity responsible for performing tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- C. Reports: Prepare and submit certified written reports that include, but are not limited to, the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.

- 13. Recommendations on retesting and reinspecting.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
- E. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. 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.
- D. 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.
- 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 to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications 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. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
 - 3. Each independent inspection and testing agency engage on the Project shall be authorized by authorities having jurisdiction to operate in the state where the project is located.
 - 4. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

- 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
- 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.7 QUALITY CONTROL

- A. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting 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 inspecting 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 they so direct.
- B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."
- 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 location from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

- 6. Do not perform any duties of Contractor.
- 7. The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections
- E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Contractor responsible to Schedule times for tests, inspections, obtaining samples, and similar activities.
- G. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for.
 - 1. Distribution: Distribute schedule to Owner, Architect testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.8 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Conducted by a qualified testing agency and/or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
 - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and 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 with copy to Contractor and to authorities having jurisdiction.
 - 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 - 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 - 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. 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 modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 - 2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

1.3 DEFINITIONS

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties", "systems", "structure", "finishes", "accessories", and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
- B. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- C. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- D. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.

- c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
- e. Samples, where applicable or requested.
- f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
- g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
- h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
- i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
- j. Cost information, including a proposal of change, if any, in the Contract Sum.
- k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
- 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.
- Architect's Action: If necessary, Architect will request additional information or documentation
 for evaluation within 15 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 15 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Acceptance: Change Order.
 - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- B. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - Architect's Action: If necessary, Architect will request additional information or documentation
 for evaluation within one week of receipt of a comparable product request. Architect will notify
 Contractor of approval or rejection of proposed comparable product request within 15 days of
 receipt of request, or 15 days of receipt of additional information or documentation, whichever
 is later.
 - a. Form of Approval: As specified in Division 1 Section "Submittal Procedures."
 - b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to the fullest extent possible

- B. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
- B. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:
 - 1. No available domestic product complies with the Contract Documents.
 - 2. Domestic products that comply with the Contract Documents are available only at prices or terms substantially higher than foreign products that comply with the Contract Documents.
- D. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
 - a) Name of product and manufacturer.
 - b) Model and serial number.
 - c) Capacity.
 - d) Speed.
 - e) Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

- 1. Store products to allow for inspection and measurement of quantity or counting of units.
- 2. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction
- 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
- 4. Store cementitious products and materials on elevated platforms.
- 5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
- 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
- 7. Protect stored products from damage and liquids from freezing.
- 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on

product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

- 1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
 - 3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: Where 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 not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 - 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 - 7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product. Include cut-sheets for any equipment item substitution.

2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Unless noted in specific specification sections, Architect will consider requests for substitution if received within 15 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
- B. 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:
 - 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.
 - 2. Requested substitution does not require extensive revisions to the Contract Documents.

- 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- 4. Substitution request is fully documented and properly submitted.
- 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
- 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
- 7. Requested substitution is compatible with other portions of the Work.
- 8. Requested substitution has been coordinated with other portions of the Work.
- 9. Requested substitution provides specified warranty.
- 10. 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.

2.3 COMPARABLE PRODUCTS

- A. Conditions: Architect will consider Contractor's request for comparable product 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:
 - 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 3. Evidence that proposed product provides specified warranty.
 - List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

3.1 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
 - 1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
 - 2. If the power, plumbing, or gas lines shown on the drawings are insufficient for the equipment supplied, the Equipment Contractor is to inform the Architect of the discrepancy(s).

END OF SECTION 016000

SECTION 017000 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.

PART 2 - EXECUTION

2.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
- B. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

2.2 PREPARATION

A. 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.

- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

2.3 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.

2.4 INSTALLATION

- General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

2.5 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

- Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
- 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
- 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

2.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

2.7 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017000

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SECTION 017310 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.3 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days, well in advanced, before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to In-Place Construction: Describe anticipated results in terms of existing construction. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
 - 7. Architect's and/or Construction Manager's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
 - Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
- a. Foundation construction.
- b. Bearing and retaining walls.
- c. Structural concrete.
- d. Structural steel.
- e. Lintels.
- f. Timber and primary wood framing.
- g. Structural decking.
- h. Miscellaneous structural metals.
- i. Equipment supports.
- i. Piping, ductwork, vessels, and equipment.
- k. Structural systems of special construction in Division 13 Sections

- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include, but are not limited to the following:
 - 1. Primary operational systems and equipment.
 - 2. Air or smoke barriers.
 - 3. Fire-suppression systems.
 - 4. Mechanical systems piping and ducts.
 - 5. Control systems.
 - 6. Communication systems.
 - 7. Conveying systems.
 - 8. Electrical wiring systems.
 - 9. Operating systems of special construction in Division 13 Sections.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include, but are not limited to the following:
 - 1. Water, moisture, or vapor barriers.
 - 2. Membranes and flashings.
 - 3. Exterior curtain-wall construction.
 - Equipment supports.
 - 5. Piping, ductwork, vessels, and equipment.
 - 6. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
 - If possible, retain the original Installer or fabricator to cut and patch the exposed Work listed below. If it is impossible to engage the original Installer or fabricator, engage another recognized experienced and specialized firm.
- a. Firestopping.
- b. Window wall system.
- c. Acoustical ceilings.
- d. CMU
 - E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting, and patching are to be performed.
 - 1. Before proceeding, meet at the Project Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
 - 2. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 3. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- E. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw, Carborundum or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.

- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces
 - 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION

SECTION 017320- SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of a building or structure.
 - 2. Repair procedures for selective demolition operations.
- B. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- C. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- D. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- E. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.2 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.
- B. Items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.3 SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Locations of temporary partitions and means of egress.
 - 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- E. Pre-demolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.4 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Professional Engineer Qualifications: Comply with Division 1 Section "Quality Requirements."
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.5 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 - 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- C. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- D. Hazardous Materials: It is expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials to be removed by Contractor. Refer to report at the end of this section.
- E. Storage or sale of removed items or materials on-site will not be permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.6 WARRANTY

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

B.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 - Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Refer to Division 15 and 16 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

- A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. Pest Control: Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations.
- C. 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.
 - Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- D. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
 - Construct dustproof partitions of not less than nominal 4 inch (100 mm) studs, 5/8 inch (16 mm) gypsum wallboard with joints taped on occupied side, and 1/2 inch (13 mm) fire-retardant plywood on the demolition side.

Insulate partition to provide noise protection to occupied areas.

Seal joints and perimeter. Equip partitions with dustproof doors and security locks.

Protect air-handling equipment.

Weatherstrip openings.

- E. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
 - Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- C. Cleaning: 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.

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. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain adequate ventilation when using cutting torches.
 - 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 9. Dispose of demolished items and materials promptly.
 - 10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- B. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

- B. Patching: Comply with Division 1 Section "Cutting and Patching."
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 - Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.
- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- E. Floors and Walls: Where walls or partitions that are demolished 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 existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.8 CLEANING

- A. Sweep the building broom clean on completion of selective demolition operation.
- B. Change filters on air-handling equipment on completion of selective demolition operations

END OF SECTION

SECTION 041000 - MORTAR

PART ONE - GENERAL

1.1 DESCRIPTION

1.1.1 Scope:

- 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all mortar work.
- 2. This Section specifies the mortar for masonry materials specified in the following:
- 1.1.2 Related Sections:

Grout Section 03600

Unit Masonry Construction Section 04200

1.2 QUALITY ASSURANCE

1.2.1 Requirements of Regulatory Agencies: Wherever a fire-resistance classification is shown or scheduled for unit masonry construction (4-hour, 3-hour and similar designations), provide mortar and proportions complying with the requirements established by UL and other governing authorities.

1.2.2 Codes:

Comply with the applicable requirements of ASTM C270 for types of mortar Work specified.

1.2.3 Source Quality Control:

- Do not change source or brands of mortar materials during the course of the Work.
- 2. Where question of compliance to the requirements of this Section arise the mortar properties specification shall take precedence over the mortar proportion specifications.
- 3. No change shall be made in the proportions established for mortar accepted under the property specifications nor shall materials with different physical characteristics be utilized in mortar used in the Work unless compliance with the requirements of the property specifications is reestablished by Shop Drawing data submission to ENGINEER.
- 4. Two air entraining materials shall not be combined in mortar.
- 1.2.4 Reference Standards: Comply with applicable provisions and recommendations of:
 - 1. ASTM C 5, Quicklime for Structural Purposes.
 - 2. ASTM C 91, Masonry Cement.
 - ASTM C 136, Sieve or Screen Analysis of Fine and Coarse Aggregates.
 - ASTM C 144, Aggregate for Masonry Mortar.
 - 5. ASTM C 150, Portland Cement.
 - 6. ASTM C 404, Aggregates for Masonry Grouts.

- 7. ASTM C 476, Grout for Masonry.
- 8. UL, Design Numbers U901 through U908.

1.3 SUBMITTALS

1.3.1 Shop Drawings:

Submit for approval in accordance with Section 01340, SUBMITTALS, copies of manufacturer's specifications and instructions for each manufactured product.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

1.4.1 Delivery of Materials:

Manufactured materials, such as cement and lime, shall be delivered and stored in their original containers, plainly marked with identification of materials and manufacturer.

1.4.2 Storage of Materials:

- 1. Store mortar materials off the ground in a dry location and under a properly constructed shelter using tarpaulins, felt paper, or polyethylene sheets.
- 2. Protect liquid admixtures from freezing.

PART TWO - PRODUCTS

2.1 MATERIALS

- 2.1.1 Portland Cement: Provide the following for portland cement-lime mortars:
 - 1. ASTM C150, Type I.
 - 2. Use ASTM C150, Type III, high early strength, for laying masonry when outside temperature is less than 50 F.
 - Provide nonstaining portland cement of natural color or of the color required to be compatible
 with the required colored mortar pigment selected by Architect from manufacturers full range
 of color selections.
 - 4. Product and Manufacturer: Provide one of the following:
 - a. Speed Portland Cement and Hi-Speed Portland Cement by Louisville Cement Company.
 - b. Atlas Type I and Atlas Type III Portland Cement by Lehigh Portland Cement Company.
 - c. Or equal.

2.1.2 Masonry Cement: Provide the following for masonry cement mortars:

- 1. ASTM C91, Type S; proportioned as specified to comply with ASTM C270.
- 2. Maximum Air Content, ASTM C 91: 18 percent.

2.1.3 Sand Aggregates:

- 1. ASTM C144, except for joints less than 1/4 inch use aggregate graded with 100 percent passing the No. 16 sieve.
- Course Aggregate for Grout: ASTM C404, Size No. 8 or Size No. 89.
- 2.1.4 Water: Free from injurious amounts of oils, acids, alkalis, or organic matter, and clean, fresh and potable.
- 2.1.5 Waterproofing Admixture:
 - 1. Proportion: In strict accordance with manufacturer's instructions.
 - 2. Product and Manufacturer: Provide one of the following:
 - Omicron by Master Builders Company.
 - b. Hydrocide Powder by Sonneborn Building Products Division Rexnord Chemical Products Incorporated.
 - c. Or equal.

2.2 MORTAR MIXES

2.2.1 General:

- 1. Anti-Freeze Admixture or Agents: Not permitted.
- 2. Calcium Chloride: Not permitted.

2.2.2 Fire Resistant Mortar:

- 1. Standard: UL Design Numbers 0901, 0902, 0903, 0904, 0905, 0906, 0907 and 0908.
- 2. Proportion: Use 1 part portland cement, 3 parts clean sand, and 15 percent hydrated lime (by cement volume)
- 2.2.3 Mortar for All Other Unit Masonry:

Comply with ASTM C270, Table 2, except limit materials to those specified herein, do not substitute ASTM Cÿ91 masonry cement for ASTM C150 portland cement without an approved Shop Drawing review by ENGINEER, and limit cement to lime ratio by volume as follows:

1. Type M:

Provide the following proportions by volume:

- a. Portland Cement: 1 part.
- b. Masonry Cement: 1 part.
- 2. Aggregate Ratio (Measured in a Damp Loose Condition): Not less than 21/4 and not more than 3 times the sum of the volumes of cement and lime.

- a. Property Specification:
 - 1. Average Compressive Strength, ASTM C270: 2500 pounds per square inch.
 - 2 Minimum Water Retention, ASTM C270: 75 percent.
 - 3. Maximum Air Content, ASTM C270: 18 percent.
- 3 Type S:

Provide the following proportions by volume:

- a. Portland Cement: 1/2 part.
- b. Masonry Cement: 1 part.
- c. Aggregate Ratio (Measured in a Damp Loose Condition): Not less than 21/4 and not more than 3 times the sum of the volumes of cement and lime.
- d. Property Specification:
 - 1. Average Compressive Strength, ASTM C270: 1800 pounds per square inch.
 - 2. Minimum Water Retention, ASTM C270: 75 percent.
 - 3. Maximum Air Content, ASTM C270: 18 percent.

2.2.4 Grout:

1. Fine Grout:

Provide the following proportions by volume:

- a. Portland Cement: 1 part.
- b. Hydrated Lime or Lime Putty: 0 to 1/10 part.
- 2. Aggregate Ratio (Measured in a Damp Loose Condition): Sand; not less than 21/4 and not more than 3 times the sum of the volumes of cement and lime.
 - a. Mix grout to have a slump of 10-inches plus or minus 1-inch, at time of placement.
- 3. Coarse Grout:

Provide the following proportions by volume:

- a. Portland Cement: 1 part.
- b. Hydrated Lime or Lime Putty: 0 to 1/10 part.
- c. Fine Aggregate Ratio (Measured in a Damp Loose Condition): Sand; not less than 2-1/4 and not more than 3 times the sum of the volumes of cement and lime.
- 4. Coarse Aggregate Ratio:

Not less than 1 and not more than 2 times the sum of the volumes of cement and lime.

- a. Mix grout to have a slump of 10-inches plus or minus 1-inch, at time of placement.
- 5. Grout Fill Around Reinforcement in Masonry Lintels:

Portland cement, sand, gravel and water, to be proportioned as required to provide a 28-day minimum compressive strength of 3000 pounds per square inch.

PART THREE - EXECUTION

3.1 PREPARATION

3.1.1 Measurement of Materials:

- 1. Cement and Hydrated Lime: Batched by the bag.
- 2. Sand: Batched by volume in suitably calibrated containers, provided proper allowance is made for bulking and consolidation and for weight per cubic foot, of contained moisture.
- 3. Proportion of Volumetric Mixtures: One 94-pound sack of portland cement and one 50-pound sack of hydrated lime constitute nominal one cubic foot.
- Shovel measurement: Not permitted.

3.1.2 Mortar Mixing:

1. Type of Mixer:

Machine mix in approved mixer in which the quantity of water is accurately and uniformly controlled.

- 2. While mixer is in operation add approximately 3/4 the required water, 1/2 the sand, all the cement, then add remainder of sand.
- Allow batch to mix briefly then add water in small quantities until satisfactory workability is obtained.
- Mix for not less than five minutes after all materials have been added.
- 5. Hydrated Lime for Mortar Requiring Lime Content:

Use dry mix method. Turn over together the materials for each batch until the even color of the mixed, dry materials indicates that cementitious material has been thoroughly distributed throughout the mass, then add water to obtain required plasticity.

- 6. Lime putty if approved for use shall be prepared in accordance with ASTM C 5.
- 7. Waterproofing Admixture:

Add to mortar mix for all exterior masonry in strict accordance with manufacturer's instructions.

- 8. The mixer drum shall be completely emptied before recharging the next batch.
- 9. Limit batch size to avoid retempering. Retempering of mortar shall not be permitted.

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- 3.2 INSTALLATION
- 3.2.1 Refer to the following:

Unit Masonry Construction

Section 042000

- 3.3 FIELD QUALITY CONTROL
- 3.3.1 The Contractor shall engage an independent testing laboratory acceptable to Engineer, to take samples and conduct tests to evaluate air entrainment, water retention and the compliance of materials with the Specifications and to determine the compressive strength of mortar and grout. Tests shall be conducted in accordance with ASTM C 91. Tests results shall be made available to Engineer prior to the commencement of Work.
- 3.3.2 After the initial test, Engineer will require a maximum of 5 additional tests to be conducted at his discretion.

END OF SECTION

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SECTION 042010 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - Concrete unit masonry.
 - 2. Colored concrete unit masonry.
 - 3. Reinforced unit masonry.
 - 4. Masonry sealer.
 - 5. Masonry waste disposal.
 - 6. Sand blasted unit masonry.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 7 Section "Joint Sealants" for sealing joints in mockup.
- Products installed but not furnished under this Section include the following:
 - 1. Hollow metal frames in unit masonry openings specified in applicable Division 8 Sections.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops the following installed compressive strengths (f'm) at 28 days.
 - 1. For Concrete Unit Masonry: As follows, based on net area:
 - a. f'm = 1500 psi
 - 2. For Brick Unit Masonry: As follows, based on gross area:
 - a. f'm = 2000 psi
- B. Aggregates containing calcites will not be allowed in any exterior concrete masonry unit.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each different masonry unit, accessory, and other manufactured product specified.
- C. Shop drawings for reinforcing detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315 "Details and Detailing of Concrete Reinforcement" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement.
- D. Samples for initial selection of the following:
 - 1. Unit masonry samples in small-scale form showing the full range of colors and textures available for each different exposed masonry unit required.
 - 2. Colored-masonry mortar samples showing the full range of colors available.
- E. Samples for verification of the following:
 - 1. Full-size units for each different exposed masonry unit required showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction.
 - 2. Colored-masonry mortar samples for each color required showing the full range of colors expected in the finished construction. Make samples using the same sand and mortar

ingredients to be used on the Project. Label samples to indicate type and amount of colorant used.

- 3. Weep holes/vents in color to match mortar color.
- 4. Accessories embedded in the masonry.
- F. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to specifically identify exact materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Neither receipt of list nor acceptance of mockup constitutes approval of deviations from Contract Documents unless such deviations are specifically brought to the attention of the Architect and approved in writing.
- G. Material certificates for the following signed by manufacturer and Contractor, certifying that each material complies with requirements.
 - 1. Each different cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
 - 2. Each material and grade indicated for reinforcing bars.
 - 3. Each type and size of joint reinforcement.
 - 4. Each type and size of anchors, ties, and metal accessories.
- H. Material test reports from a qualified independent testing agency, employed and paid by Contractor or manufacturer, indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements indicated:
 - 1. Mortar complying with property requirements of ASTM C 270.
 - 2. Mortar complying with BIA M1.
 - 3. Grout mixes. Include description of type and proportions of grout ingredients.
 - 4. Masonry units
- I. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

- A. Contractor shall employ and pay a qualified professional engineer to provide a survey and inspection of foundations for compliance with dimensional tolerances.
- B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM C 1093, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- C. Preconstruction Testing: Employ and pay a qualified independent testing agency to perform the following preconstruction testing to establish compliance of proposed materials and construction with specified requirements:
 - 1. Concrete Masonry Unit Test: For each different concrete masonry unit indicated, test units for strength, absorption, and moisture content per ASTM C 140-90.
 - 2. Prism Test: For each type of wall construction indicated, test masonry prisms per ASTM E 447. Method B.
 - 3. Test mortar properties per test methods of ASTM C 270.
 - 4. Evaluate mortar composition and properties per ASTM C 780.
 - 5. Test grout compressive strength per ASTM C 1019.
- D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities

having jurisdiction.

- E. Single-Source Responsibility for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one source and by a single manufacturer for each different product required.
- F. Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- G. Single-Source Responsibility for Waterproofing Materials: Obtain waterproofing materials from one manufacturer for each component.
- H. Mockup: Prior to installing unit masonry, construct sample wall panels to verify selections made under sample submittals and to demonstrate aesthetic effects as well as other qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.
 - 1. Locate mockups on site in the locations indicated or, if not indicated, as directed by Architect.
 - Include exterior face masonry units.
 - b. Include window complying with requirements of Division 8 Section " Aluminum Architectural Windows."
 - Seal perimeter of window complying with requirements of Division 7 Section "Joint Sealants."
 - d. Include gutter and downspout complying with requirements of Division 7 Section "Flashing and Sheet Metal."
 - e. Include sealant-filled joint complying with requirements of Division 7 Section "Joint Sealants."
 - 2. Build mockups for the following types of masonry in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness, including face and back-up wythes as well as accessories. Include a sealant-filled joint at least 16 inches (400 mm) long in each mockup.
 - a. Each type of exposed unit masonry construction.
 - b. Typical exterior face brick wall with lower corner of window opening framed with trim at upper corner of mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
 - c. Typical exterior face brick wall with through-wall flashing installed for a 24-inch (600-mm) length in corner of mockup approximately 16 inches (400 mm) down from top of mockup with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).
 - Typical interior unit masonry wall.
 - 3. Clean exposed faces of mockups with masonry cleaner indicated.
 - 4. Notify Architect one week in advance of the dates and times when mockups will be constructed.
 - 5. Protect accepted mockups from the elements with weather-resistant membrane.
 - 6. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. Acceptance of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - b. Acceptance of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless such deviations are specifically approved by Architect in writing.
 - c. When directed, demolish and remove mockups from Project site.
 - d. Accepted mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

 Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not install until they are in an air-dried condition.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

- A. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt on completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit masonry damaged by frost or freezing conditions. Comply with the following requirements:
 - 1. Cold-Weather Construction: When the ambient temperature is within the limits indicated, use the following procedures:
 - a. 40 to 32 deg F (4 to 0 deg C): Heat mixing water or sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C).
 - b. 32 to 25 deg F (0 to -4 deg C): Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry.
 - c. 25 to 20 deg F (-4 to -7 deg C): Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg

- F (4 deg C) if grouting. Use heat on both sides of walls under construction.
- d. 20 deg F (-7 deg C) and Below: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F (4 deg C). Provide enclosures and use heat on both sides of walls under construction to maintain temperatures above 32 deg F (0 deg C) within the enclosures.
- 2. Cold-Weather Protection: When the mean daily temperature is within the limits indicated, provide the following protection:
 - a. 40 to 25 deg F (4 to -4 deg C): Cover masonry with a weather-resistant membrane for 48 hours after construction.
 - b. 25 to 20 deg F (-4 to -7 deg C): Cover masonry with insulating blankets or provide enclosure and heat for 48 hours after construction to prevent freezing. Install wind breaks when wind velocity exceeds 15 mi./h (25 km/h).
 - c. 20 deg F (-7 deg C) and Below: Provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after construction.
- 3. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried out, but not less than 7 days after completion of cleaning.
- E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Concrete Masonry Units:
 - a. Equal to EP Henry Corporation.
 - b. Equal to Trendwythe Trendstone Products
 - 2. Brick:
 - a. Gery Corporation
 - b. Belden Brick Company
 - c. Continental Brick Glen-
 - d. Endicott Clay Products
 - 3. Portland Cement, Mortar Cement, Masonry Cement, and Lime:
 - a. Essroc Materials, Inc.
 - b. Glen-Gery Corporation
 - c. Lafarge Corporation
 - d. Lehigh Portland Cement Co.
 - 4. Mortar Pigments:
 - a. Davis Colors.
 - b. Lafarge Corporation
 - c. Solomon Grind-Chem Services, Inc.
 - 5. Joint Reinforcement, Ties, and Anchors:
 - a. Dur-O-Wal. Inc.
 - b. Heckman Building Products, Inc.
 - c. Hohmann & Barnard, Inc.
 - d. Masonry Reinforcing Corp. of America
 - e. National Wire Products Industries

- f. Southern Construction Products
- 6. Masonry Waterproofing:
 - a. Vexcon Chemicals, Inc. or approved equal.

2.2 CONCRETE MASONRY UNITS

- A. General: Provide shapes indicated and as follows for each form of concrete masonry unit required.
 - 1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for exterior outside corners, except where indicated as bullnose.
- B. Concrete Masonry Units: ASTM C 90 and as follows:

All interior concrete masonry units that comprise walls of corridors and public access ways will be colored, smooth face and split face, as shown in drawings, for Dormitory. All exterior 4" concrete masonry units shall include colored smooth face, colored ground face, and colored split face.

- 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength indicated below:
 - a. 1900 psi (13.1 MPa)
 - b. Not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.
- 2. Weight Classification: Normal weight.
- 3. Aggregates: Do not use aggregates made from pumice, scoria, or tuff, limestone, or other aggregates containing calcites.
- 4. Provide Type I, moisture-controlled units.
- 5. Size: Manufactured to the actual dimensions listed below (within tolerances specified in the applicable referenced ASTM specification) for the corresponding nominal sizes indicated on Drawings:
 - a. 6 inch (150 mm) nominal: 5 5/8 inch (143 mm) actual.
 - b. 8 inch (200 mm) nominal: 7 5/8 inch (194 mm) actual.
- 6. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
- C. Decorative Concrete Masonry Units: ASTM C 90 and as follows:
 - Unit Compressive Strength: Provide units with minimum average net-area compressive strength indicated below:
 - a. 1900 psi (13.1 MPa)
 - b. Not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.
 - 2. Weight Classification: Normal weight.
 - 3. Provide Type I, moisture-controlled units.
 - 4. Size: Manufactured to the actual dimensions indicated on the Drawings within the tolerances specified in the applicable referenced ASTM specification.
 - 5. Finish: Exposed faces of the following general description matching color, pattern, and texture of Architect's sample.
 - a. Normal-weight aggregate, split-face finish and colored smooth face.
 - 1) Provide units made with aggregate matching aggregate in Architect's sample.
 - 6. Integral Water Repellent: Provide units produced with liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of the test specimen.
 - a. Product: Subject to compliance with requirements, provide units made with "Dry-Block" by W.R. Grace & Co.

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Masonry Cement: ASTM C 91.
 - All mortars, shall be integrally colored, selected from manufacturer's standard color pallets, as chosen by the Architect, intended to match the color and hue of the chosen concrete masonry units, i.e., white block, white mortar, red block, red mortar, etc. Use premixed, colored masonry cements of formulation required to produce color indicated, or if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 5 percent of masonry cement by weight for mineral oxides nor 1 percent for carbon black.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.
 - For pigmented mortars, use colored portland cement-lime mix of formulation required to produce color indicated, or if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 10 percent of portland cement by weight for mineral oxides nor 2 percent for carbon black.
- D. Aggregate for Grout: ASTM C 404.
- E. Ready-Mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified in this Article; combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C 1142.
- F. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMU, containing integral water repellent by same manufacturer.
- G. Water: Potable.
- H. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Colored Masonry Cement:
 - a. Norval; Scancam Group, Lafayette, New Jersey
 - b. Centurion Colorbond; Lafarge Corporation.
 - c. Lehigh Custom Color Masonry Cement; Lehigh Portland Cement Co.
 - d. Blue Circle Magnolia; Bayonne, New Jersey
 - 2. Colored Portland Cement-Lime Mix:
 - a. Norval; Scancam Group, Lafayette, New Jersey
 - b. Centurion Colorbond: Lafarge Corporation
 - c. Lehigh Custom Color Masonry Cement; Lehigh Portland Cement Co.
 - d. Blue Circle Magnolia; Bayonne, New Jersey
 - Mortar Pigments:
 - a. True Tone Mortar Colors; Davis Colors.
 - b. Centurion Pigments; Lafarge Corporation
 - c. SGS Mortar Colors; Solomon Grind-Chem Services, Inc.
 - Water-Repellent Admixture:
 - a. Dry-Block Mortar Admixture; Grace: W.R. Grace & Co.

2.5 REINFORCING STEEL

- A. Steel Reinforcing Bars: Material and grade as follows:
 - 1. Epoxy-coated billet steel complying with ASTM A 615 (ASTM A 615M) and ASTM A 775 (ASTM A 775M).
 - Grade 60 (Grade 400).
- B. Deformed Reinforcing Wire: ASTM A 496, with ASTM A 153, Class B-2 zinc coating.

2.6 JOINT REINFORCEMENT

A. General: Provide joint reinforcement formed from the following:

- 1. Galvanized carbon-steel wire, coating class as follows:
 - a. ASTM A 641 (ASTM A 641M), Class 1, for interior walls; and ASTM A 153, Class B-2, for exterior walls.
- B. Description: Welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet (3 m), with prefabricated corner and tee units, and complying with requirements indicated below:
 - 1. Wire Diameter for Side Rods: 0.1875 inch (4.8 mm).
 - 2. Wire Diameter for Cross Rods: 0.1875 inch (4.8 mm).
- C. For single-wythe masonry, provide type as follows with single pair of side rods:
 - Truss design with continuous diagonal cross rods spaced not more than 16 inches (407 mm)
 o.c.
- D. For multiwythe masonry, provide type as follows:
 - 1. Ladder design with perpendicular cross rods spaced not more than 16 inches (407 mm) o.c.
 - a. Number of Side Rods for Multiwythe Concrete Masonry: One side rod for each face shell of hollow masonry units more than 4 inches (100 mm) in width, plus 1 side rod for each wythe of masonry 4 inches (100 mm) or less in width.
 - b. Provide integral drips on cross rods at cavity walls.

2.7 TIES AND ANCHORS, GENERAL

- A. General: Provide ties and anchors specified in subsequent articles that comply with requirements for metal and size of this Article, unless otherwise indicated.
 - B. Wire: As follows:
 - 1. Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating for wire ties and anchors in exterior walls.
 - 2. Wire Diameter: 0.25 inch (6.4 mm).
 - C. Steel Sheet: As follows:
 - Galvanized Steel Sheet: ASTM A 366 (ASTM A 366M) (commercial quality) cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153, Class B-2 or B-3, as applicable, for sheet-metal ties and anchors in exterior walls not completely embedded in mortar and grout.
 - D. Thickness of Steel Sheet Galvanized After Fabrication: Uncoated thickness of steel sheet for hot-dip galvanizing after fabrication:
 - 1. 0.1046 inch (2.7 mm).
 - E. Galvanized Heavy-Thickness Steel Sheet: ASTM A 635 (ASTM A 635M) (commercial quality) hotrolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153, Class B-2 or B-3, as applicable, for rigid anchors fabricated from steel sheet or strip with a thickness of 0.180 inch (4.6 mm) and greater.

2.8 ADJUSTABLE ANCHORS FOR CONNECTING TO STRUCTURAL FRAME

- A. General: Provide 2-piece assemblies as described below, allowing vertical or horizontal differential movement between wall and frame parallel to plane of wall but resisting tension and compression forces perpendicular to it.
 - For anchorage to concrete, provide manufacturer's standard anchors with dovetail anchor section formed from sheet metal and triangular-shaped wire tie section sized to extend within 1 inch (25 mm) of masonry face and as follows:
 - a. Wire Diameter: 0.25 inch (6.4 mm).

2.9 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron inserts of type and size indicated.
- B. Dovetail Slots: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.0336-inch (0.85-mm), galvanized steel sheet.
- C. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:
 - 1. Headed bolts.
 - 2. Nonheaded bolts, straight.
 - 3. Nonheaded bolts, bent in manner indicated.
- D. Postinstalled Anchors: Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - Type: Expansion anchors.
 - 2. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Alloy Group 1 or 4) for bolts and nuts; ASTM A 167 or ASTM A 276, Type 304 or 316, for anchors.
 - 3. For Postinstalled Anchors in Concrete: Capability to sustain, without failure, a load equal to 4 times the loads imposed by masonry.
 - 4. For Postinstalled Anchors in Grouted Concrete Masonry Units: Capability to sustain, without failure, a load equal to 6 times the loads imposed by masonry.

2.10 EMBEDDED FLASHING MATERIALS

- A. Sheet-Metal Flashing: Fabricate from the following metal complying with requirements specified in Division 7 Section "Flashing and Sheet Metal" and below:
 - 1. Stainless Steel: 0.0156 inch (0.4 mm) thick.
 - 2. Fabricate through-wall metal flashing embedded in masonry as follows:
 - a. With ribs formed in sawtooth pattern at 3-inch (75-mm) intervals along length of flashing to provide a 3-way integral mortar bond and weep-hole drainage.
 - Fabricate metal expansion-joint strips from sheet metal indicated above, formed to shape indicated.
 - 4. Application: Use where flashing is fully or partly concealed in masonry wall.
- B. Reinforced Plastic Flashing: Manufacturer's standard composite plastic flashing as described below:
 - 1. Metal foil, 0.33 mil (0.008 mm) thick, encapsulated between polyester film and bonded to fiberglass scrim reinforcement, with a total thickness of 7 mils (0.18 mm).
 - 2. Joint Tape: Reinforced plastic flashing manufacturer's standard polyester tape, 2 inches (50 mm) wide by 2.0 mils (0.05 mm) thick.
 - 3. Application: Use where flashing is fully concealed in masonry.
- C. Rubberized Asphalt Sheet Flashing: Manufacturer's standard composite flashing product consisting of a pliable and highly adhesive rubberized asphalt compound, 32 mils (0.8 mm) thick, bonded completely and integrally to a high-density, cross-laminated polyethylene film, 8 mils (0.2 mm) thick, to produce an overall thickness of 40 mils (1.0 mm).
 - 1. Primer: Flashing manufacturer's standard product or product recommended by flashing manufacturer for bonding flashing sheets to masonry and concrete.
- D. Rubberized Asphalt Sheet Flashing: Manufacturer's standard composite flashing product consisting of a pliable and highly adhesive rubberized asphalt compound, 26 mils (0.7 mm) thick, bonded completely and integrally to a high-density, cross-laminated polyethylene film, 4 mils (0.1 mm) thick, to produce an overall thickness of 30 mils (0.8 mm).

- 1. Primer: Flashing manufacturer's standard product or product recommended by flashing manufacturer for bonding flashing sheets to masonry and concrete.
- E. Solder and Sealants for Sheet-Metal Flashings: As specified in Division 7 Section "Flashing and Sheet Metal."
- F. Adhesive for Flashings: Of type recommended by manufacturer of flashing material for use indicated.
- G. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Metal Flashing:
 - a. Cheney Flashing (Dovetail); Cheney Flashing Company, Inc.
 - b. Cheney Flashing (Sawtooth); Cheney Flashing Company, Inc.
 - c. Keystone 3-Way Interlocking Thruwall Flashing; Keystone Flashing Co.
 - 2. Reinforced Plastic Flashing:
 - a. Fiberweb 300; Fiberweb International Corp.
 - b. Fiberweb 200; Fiberweb International Corp.
 - 3. Rubberized Asphalt Sheet Flashing:
 - a. Perm-A-Barrier Wall Flashing; Grace: W.R. Grace & Co.
 - b. Polyguard 300; Polyguard Products, Inc.

2.11 MASONRY WATERPROOFING

- A. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Masonry Waterproofing:
 - a. Vexcon Powerseal 40, Vexcon Chemicals, Inc. AND
 - b. Vexcon Starseal 1315 Beading Flat, Vexcon Chemicals, Inc.

2.12 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Type 2, Class A, Grade 1; compressible up to 35 percent; of width and thickness indicated; formulated from the following material:
 - 1. Neoprene
 - 2. Urethane
- B. Preformed Control-Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
 - 1. Styrene-Butadiene Rubber Compound: ASTM D 2000, Designation M2AA-805.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep Holes: Provide the following:
 - 1. Round Plastic Tubing: Medium-density polyethylene, 3/8-inch (9-mm) outside diameter by 4 inches (100 mm) long.
 - 2. Available Products: Subject to compliance with requirements, weep hole/ventilators that may be incorporated in the Work include, but are not limited to, the following:
 - a. Plastic Weep Hole/Vent:
 - 1) Cell Vent; Dur-O-Wal, Inc.
- E. Cavity Drainage Material: 1-inch- (25-mm-) thick, reticulated, nonabsorbent mesh, made from polyethylene strands and shaped to maintain drainage at weep holes without being clogged by mortar droppings.
 - 1. Product: Subject to compliance with requirements, provide "Mortar Net" by Mortar Net USA, Ltd.

2.13 INSULATION

- A. Polyisocyanurate Board Insulation: Glass-fiber-reinforced, rigid, closed-cell foam board; produced by expanding polyisocyanurate resin without using chlorofluorocarbons (CFCs); with aluminum foil facings laminated to both sides; complying with FS HH-I-1972/1, Class 2; with a thermal resistance (R-value) for 1-inch (25-mm) thickness of 6.2 deg F x sq. ft. x h/Btu at 75 deg F (1.1 K x sq. m/W at 24 deg C); in manufacturer's standard lengths and widths; and in thicknesses indicated.
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.14 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.

2.15 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Add cold-weather admixture (if used) at the same rate for all mortar, regardless of weather conditions, in order to ensure that mortar color is consistent.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for types of mortar indicated below:
 - 1. Limit cementitious materials in mortar to Portland cement and lime.
 - 2. For masonry below grade, in contact with earth, and where indicated, use type indicated below:
 - a. Type: S.
 - 3. For reinforced masonry and where indicated, use type indicated below:
 - a. Type: S.
 - 4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions, and for other applications where another type is not indicated, use type indicated below:
 - a. Type: N.
- C. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required.
 - 1. Limit pigments to the following percentages of cement content by weight:
 - a. For mineral oxide pigments and portland cement-lime mortar, not more than 10 percent.
 - b. Mix to match Architect's sample.
- D. Grout for Unit Masonry: Comply with ASTM C 476. Use grout of consistency indicated or, if not otherwise indicated, of consistency (fine or coarse) at time of placement that will completely fill spaces intended to receive grout.
 - 1. Use fine grout in grout spaces less than 2 inches (50 mm) in horizontal dimension, unless otherwise indicated.
 - 2. Use coarse grout in grout spaces 2 inches (50 mm) or more in least horizontal dimension, unless otherwise indicated.

2.15 SOURCE QUALITY CONTROL

A. The Owner will engage and pay for the services of an independent testing agency to perform the following testing for source quality control. Payment for these services will be made from the Inspection and Testing Allowance, as authorized by Change Orders. Retesting of materials failing to

meet specified requirements shall be done at Contractor's expense.

B. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested for strength, absorption, and moisture content per ASTM C 140.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of unit masonry. Do not proceed with installation until unsatisfactory conditions have been corrected.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of unit masonry.
- B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of thickness indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections of the Specifications.
- C. Leave openings for equipment to be installed before completion of masonry. After installing equipment, complete masonry to match construction immediately adjacent to the opening.
- D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting, where possible. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.

3.3 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of columns, walls, and arises, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), nor 3/8 inch in 20 feet (10 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For vertical alignment of head joints, do not exceed plus or minus 1/4 inch in 10 feet (6 mm in 3 m), nor 1/2 inch (12 mm) maximum.
- B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For top surface of bearing walls, do not exceed 1/8 inch (3 mm) in 10 feet (3 m), nor 1/16 inch (1.5 mm) within width of a single unit.
- C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls, and partitions, do not exceed 1/2 inch in 20 feet (12 mm in 6 m), nor 3/4 inch in 40 feet (19 mm in 12 m) or more.
- D. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4 inch (6 mm) nor plus 1/2 inch (12 mm).

E. Variation in Mortar-Joint Thickness: Do not vary from bed-joint thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary bed-joint thickness from bed-joint thickness of adjacent course by more than 1/8 inch (3 mm). Do not vary from head-joint thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary head-joint thickness from adjacent head-joint thickness by more than 1/8 inch (3 mm). Do not vary from collar-joint thickness indicated by more than minus 1/4 inch (6 mm) or plus 3/8 inch (10 mm).

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.
- B. Lay walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.
- C. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
 - One-half running bond with vertical joint in each course centered on units in courses above and below.
- D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches (50 mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- E. Stopping and Resuming Work: In each course, rack back 1/2-unit length for one-half running bond or 1/3-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar prior to laying fresh masonry.
- F. Built-in Work: As construction progresses, build-in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.
- G. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
 - 1. At exterior frames, insert extruded polystyrene board insulation around perimeter of frame in thickness indicated, but not less than 3/4 inch (19 mm) to act as a thermal break between frame and masonry.
- H. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
- I. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- J. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above and as follows:
 - Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
 - 1. With full mortar coverage on horizontal and vertical face shells and cross webs.
 - 2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
 - 3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
 - 4. Maintain joint widths indicated, except for minor variations required to maintain bond

alignment. If not indicated, lay walls with 3/8-inch (10-mm) joints.

- B. Lay solid brick-size masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not furrow bed joints or slush head joints.
 - 1. At cavity walls, slope beds toward cavity to minimize mortar protrusions into cavity. As work progresses, trowel mortar fins protruding into cavity flat against cavity face of block.
- C. Tool exposed exterior joints sloping inward from bottom to top to produce a weather joint. Bottom to be flush with vertical face of block below.
- D. Too exposed interior joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- E. Cut joints flush for masonry walls that are to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.6 STRUCTURAL BONDING OF MULTIWYTHE MASONRY

- A. Use continuous horizontal-joint reinforcement installed in horizontal mortar joints for bond tie between wythes.
- B. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.
 - Provide continuity with horizontal-joint reinforcement at corners by using prefabricated "L" units in addition to masonry bonding.
- C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:
 - 1. Provide continuity with horizontal-joint reinforcement by using prefabricated "T" units.

3.7 CAVITIES

- A. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.
 - 1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.
- B. Tie exterior wythe to back-up with continuous horizontal-joint reinforcing.

3.8 CAVITY-WALL INSULATION

- A. On units of plastic board insulation, place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c., both ways on inside face or attach to inside face with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 - Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.9 HORIZONTAL-JOINT REINFORCEMENT

- A. General: Provide continuous horizontal-joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcing a minimum of 6 inches (150 mm).
 - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
 - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement in mortar joint 1 block course above and below wall openings and extending 12 inches (305 mm) beyond opening.

- a. Reinforcement above is in addition to continuous reinforcement.
- B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.10 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 - 1. Provide an open space not less than 1 inch (25 mm) in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
 - 2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. in both directions.

3.11 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joints in unit masonry where indicated. Build-in related items as the masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Fit bond-breaker strips into hollow contour in ends of block units on one side of control joint. Fill the resultant core with grout and rake joints in exposed faces.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install temporary foam plastic filler in head joints and remove when unit masonry is complete.
- C. Build-in horizontal pressure-relieving joints where indicated; construct joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants."
 - Locate horizontal pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

3.12 LINTELS

- A. Provide lintels where shown and where openings of more than 24 inches (610 mm) for block size units are shown without other supporting lintels.
 - 1. Provide steel lintels as indicated on drawings. All exposed steel lintels are to be primed and painted. See painting spec..
- B. Provide minimum bearing of 8 inches (200 mm) at each jamb, unless otherwise indicated.

3.13 FLASHING, WEEP HOLES, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.
- B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer before covering with mortar.
- C. Install flashing as follows:
 - 1. At composite masonry walls, including cavity walls, extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4 inches (100 mm), and through the inner wythe to within 1/2 inch (13 mm) of the interior face of the wall in exposed masonry. Where interior surface of inner wythe is concealed by furring, carry flashing

- completely through the inner wythe and turn up approximately 2 inches (50 mm), unless otherwise indicated.
- 2. At lintels and shelf angles, extend flashing a minimum of 4 inches (100 mm) into masonry at each end. At heads and sills, extend flashing 4 inches (100 mm) at ends and turn up not less than 2 inches (50 mm) to form a pan.
- 3. Cut off flashing flush with face of wall after masonry wall construction is completed.
- D. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:
 - 1. Form weep holes with product specified in Part 2 of this Section.
 - 2. Form weep holes by keeping head joints free and clear of mortar.
 - 3. Space weep holes 16 inches (400 mm) o.c.
 - 4. In cavities, place pea gravel to a height equal to height of first course, but not less than 2 inches (50 mm), immediately above top of flashing embedded in the wall, as masonry construction progresses, to splatter mortar droppings and to maintain drainage.
 - 5. Place cavity drainage material immediately above flashing in cavities.
- E. Install vents in vertical head joints at the top of each continuous cavity. Space vents and close off cavities vertically and horizontally with blocking in manner indicated.
 - 1. Install through-wall flashing and weep holes above horizontal blocking.
- F. Install reglets and nailers for flashing and other related construction where shown to be built into masonry.

3.14 FIELD QUALITY CONTROL

- A. The Owner will engage and pay for the services of an independent testing agency to perform the following testing for field quality control. Payment for these services will be made from the Inspection and Testing Allowance, as authorized by Change Orders. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
- B. Testing Frequency: Tests and Evaluations listed in this Article will be performed during construction for each 5000 sq. ft. (460 sq. m) of wall area or portion thereof.
- C. Mortar properties will be tested per property specification of ASTM C 270.
- D. Grout will be sampled and tested for compressive strength per ASTM C 1019.
- E. Prism-Test Method: For each type of wall construction indicated, masonry prisms will be tested per ASTM E 447, Method B, and as follows:
 - 1. Prepare 1 set of prisms for testing at 7 days and 1 set for testing at 28 days.
- F. Evaluation of Quality-Control Tests: In the absence of other indications of noncompliance with requirements, masonry will be considered satisfactory if results from construction quality-control tests comply with minimum requirements indicated.

3.15 PARGING

- A. Parge predampened masonry walls, where indicated, with Type S or Type N mortar applied in 2 uniform coats to a total thickness of 3/4 inch (19 mm). Scarify first parging coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot (3 mm per 300 mm). Form a wash at top of parging and a cove at bottom.
- C. Damp cure parging for at least 24 hours and protect until cured.

3.16 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units; install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point-up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for application of sealants.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears prior to tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
 - Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - 5. Clean block by bucket and brush hand-cleaning method described in BIA Technical Note No. 20 Revised, using the following masonry cleaner:
 - a. Job-mixed detergent solution
- E. Protection: Provide final protection and maintain conditions that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

3.17 MASONRY WASTE DISPOSAL

- A. Recycling: Undamaged, excess masonry materials are Contractor's property and shall be removed from the Project site for his use.
- B. Disposal as Fill Material: Dispose of clean masonry waste, including broken masonry units, waste mortar, and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches (100 mm) in greatest dimension.
 - 2. Mix masonry waste with at least 2 parts specified fill material for each part masonry waste. Fill material is specified in Division 2 Section "Earthwork."
 - Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.
- C. Excess Masonry Waste: Remove excess, clean masonry waste that cannot be used as fill, as described above, and other masonry waste and legally dispose of off Owner's property.

UNIT MASONRY SCHEDULE

See Architectural Drawings for CMU Locations and Types.

CONCRETE MASONRY UNITS

<u>General:</u> Comply with requirements indicated below applicable to each form of concrete masonry unit required. Provide special Shapes where indicated and as follows:

For window sills, lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions. Radius Corner units for outside corners typical.

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<u>Size:</u> Provide concrete masonry units complying with requirements indicated below for size that are manufactured to specified face dimensions within tolerances specified in the applicable referenced ASTM specification for concrete masonry units. Refer to Architectural Drawings for CMU sizes.

<u>Concrete Masonry Units:</u> Manufactured to specified dimensions of 3/8 inch less than nominal widths by nominal heights by nominal lengths indicated on drawings and specified herein.

Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C 90, Type I

Weight Classification: Normal weight

<u>Exposed Faces:</u> Manufacturer's standard color and texture, unless otherwise indicated. Where special finishes are indicated, provide units with exposed faces of the following general description with color and texture selected from manufacturer's standard range (RockFace, Split Fluted, Smooth, etc.). Where special patterns are indicated, provide units with exposed faces, color, texture and pattern selected from manufacturer's standard range.

END OF SECTION

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - Steel trusses.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
 - 2. Division 9 Section "Gypsum Board Assemblies" for gypsum board and nonload-bearing metal-stud framing and ceiling-suspension assemblies.
 - 3. Division 9 Section "Gypsum Sheathing" for gypsum sheathing applied to exterior steel framing.
 - 4. Division 9 Section "Gypsum Board Shaft-Wall Assemblies" for gypsum board and nonload-bearing metal-stud framing assemblies.

1.3 PERFORMANCE REQUIREMENTS

- A. AISI "Specifications": Calculate structural characteristics of cold-formed metal framing according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members" and the following:
- B. AISI "Specifications": Calculate structural characteristics of cold-formed metal framing according to AISI's "Load and Resistance Factor Design Specification for Cold-Formed Steel Structural Members" and the following:
 - 1. Center for Cold-Formed Steel Structures (CCFSS) Technical Bulletin, Vol. 2, No. 1, February 1993 "AISI Specification Provisions for Screw Connections."
- C. Structural Performance: Engineer, fabricate and erect cold-formed metal framing with the following minimum physical and structural properties:
 - 1. Physical and Structural Properties: As indicated.
- D. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.
 - 1. Design Loads: As indicated.
 - 2. Design framing systems to withstand design loads without deflections greater than the following:
 - a. Roof Trusses: Vertical deflection of 1/240 of the span.

- 3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 120 deg F (67 deg C).
- 4. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
- E. Design exterior nonload-bearing curtainwall framing to accommodate lateral deflection without regard to contribution of sheathing materials.
- F. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of cold-formed metal framing, accessory, and product specified.
- C. Shop drawings showing layout, spacings, sizes, thicknesses, and types of cold-formed metal framing, fabrication, fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachments to other units of Work.
 - For cold-formed metal framing indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.
- D. Mill certificates signed by manufacturers of cold-formed metal framing certifying that their products comply with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, and galvanized-coating thickness.
 - 1. In lieu of mill certificates, submit test reports from a qualified independent testing agency evidencing compliance with requirements.
- E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- F. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Product test reports from a qualified independent testing agency evidencing compliance with requirements of the following based on comprehensive testing:
 - 1. Expansion anchors.
 - Powder-actuated anchors.
 - 3. Mechanical fasteners.

H. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence cold-formed metal framing's compliance with building code in effect for Project.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code-Steel" and AWS D1.3 "Structural Welding Code-Sheet Steel."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- D. Fire-Test-Response Characteristics: Where fire-resistance-rated assemblies are indicated, provide cold-formed metal framing identical to that tested as part of an assembly for fire resistance per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: As indicated by design designations listed in UL "Fire Resistance Directory," or by Warnock Hersey or another testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Professional Engineer Qualifications: A professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of cold-formed metal framing similar to this Project in material, design, and extent and that have a record of successful in-service performance.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated in the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
 - 1. Alabama Metal Industries Corp.
 - 2. American Studco, Inc.
 - 3. Angeles Metal Systems.
 - 4. California Metal Systems, Inc.
 - 5. Clark-Cincinnati, Inc.
 - 6. Consolidated Fabricators Corp.
 - 7. Consolidated Systems, Inc.
 - 8. Dale//Incor Industries of Florida.
 - 9. Dale Industries, Inc.
 - 10. Design Shapes in Steel.
 - 11. Dietrich Industries, Inc.
 - 12. Incor Plant Dale Industries.
 - 13. Knorr Steel Framing Systems.
 - 14. MarinoWare; Div. of Ware Industries, Inc.
 - 15. Studco of Hawaii, Inc.
 - 16. Super Stud Building Products, Inc.
 - 17. Unimast, Inc.
 - 18. United Construction Supply.
 - 19. United States Steel.
 - 20. Western Metal Lath Co.

2.2 MATERIALS

- A. Galvanized-Steel Sheet: ASTM A 446 (ASTM A 446M), zinc coated according to ASTM A 525 (ASTM A 525M), and as follows:
 - 1. Coating Designation: G 60 (Z 180).
 - 2. Coating Designation: G 90 (Z 275).
 - 3. Grade: Grade A, 33,000 psi (230 MPa) minimum yield strength, 20 percent elongation.
 - 4. Grade: Grade D, 50,000 psi (345 MPa) minimum yield strength, 12 percent elongation.
 - 5. Grade: As required by structural performance.
- B. Aluminum-Zinc-Alloy-Coated Steel Sheet: ASTM A 792 (ASTM A 792M), aluminum-zinc-alloy-coated, structural quality.
 - 1. Coating Designation: AZ 50 (AZ 150).
 - 24. Grade: Grade 33, 33,000 psi (Grade 230, 230 MPa) minimum yield strength, 20 percent elongation.
 - 2. Grade: Grade 50, 50,000 psi (Grade 345, 345 MPa) minimum yield strength, 12 percent elongation.
 - 3. Grade: As required by structural performance.

2.3 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi (230 MPa).

- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, .as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Gusset plates.
 - 5. Reinforcement plates.

2.4 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36 (ASTM A 36M), zinc coated by the hot-dip process according to ASTM A 123.
- B. Cast-in-Place Anchor Bolts and Studs: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel hex-head bolts and studs; carbon-steel nuts; and flat, unhardened-steel washers. Zinc coated by the hot-dip process according to ASTM A 153.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times the design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Powder-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times the design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.5 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and a 30-minute working time.
- D. Thermal Insulation: ASTM C 665, Type I, unfaced mineral-fiber blankets produced by combining glass or slag fibers with thermosetting resins.

2.6 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.
 - 1. Fabricate framing assemblies in jig templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding. Wire tying of framing members is not permitted.
 - 4. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to cold-framed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.
 - 5. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to manufacturer's recommendations.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or distortion.
- C. Fabrication Tolerances: Fabricate assemblies to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements, including installation tolerances and other conditions affecting performance of cold-formed metal framing. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Grout bearing surfaces uniform and level to ensure full contact of bearing flanges or track webs on supporting concrete or masonry construction.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

- B. Install cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to cold-framed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.
- C. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.
- D. Provide temporary bracing and leave in place until framing is permanently stabilized.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- F. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and double studs, inaccessible upon completion of framing work.
- G. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. Erection Tolerances: Install cold-formed metal framing to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 TRUSS INSTALLATION

- A. Install, bridge, and brace trusses according to manufacturer's recommendations and requirements of this Section.
- B. Space trusses at centers indicated.
- C. Space trusses as follows:
 - 1. Truss Spacing: 16 inches (406 mm).
 - 2. Truss Spacing: 24 inches (610 mm).
 - 3. Truss Spacing: 32 inches (813 mm).
 - 4. Truss Spacing: 400 mm.
 - 5. Truss Spacing: 600 mm.
 - 6. Truss Spacing: 800 mm.
- D. Do not alter, cut, or remove framing members or connections of trusses.

- E. Erect trusses with plane of truss webs plumb and parallel to each other, align, and accurately position at spacings indicated.
- F. Erect trusses without damaging framing members or connections.
- G. Align webs of bottom chords and load-bearing studs or continuously reinforce track to transfer loads to structure. Anchor trusses securely at all bearing points.
- H. Install continuous bridging and permanently brace trusses.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: A qualified independent testing agency employed and paid by Owner will perform field quality-control testing.
- B. Field and shop welds will be subject to inspection and testing.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace Work that does not comply with specified requirements.
- E. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanizing repair paint according to ASTM A 780 and the manufacturer's instructions.
- B. Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on fabricated and installed prime-painted, cold-formed metal framing.
 - 1. Touchup painted surfaces with same type of shop paint used on adjacent surfaces.
- C. Protect gypsum sheathing that will be exposed to weather for more than one month as follows:
 - 1. Protect cutouts, corners, and joints in the sheathing by filling with a flexible sealant or by applying tape recommended by sheathing manufacturer at the time sheathing is applied.
- D. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer to ensure that cold-formed metal framing is without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.0 SUMMARY

- A. This Section includes the following:
 - 1. Steel and aluminum ladders.
 - 2. Miscellaneous steel framing and supports.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specifications apply to this section.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Prefabricated building columns.
 - 2. Cast nosings and treads.
 - 3. Extruded nosings and treads.
 - 4. Grout.
- B. Shop Drawings: Include plans, elevations, sections, details of installation, and attachments to other Work.
- C. Templates: For anchor bolts.

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.
- B. Ferrous Metals:
 - 1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 2. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
 - 3. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
 - 4. Slotted Channel Framing: Cold-formed metal channels (41 by 41 mm) with flange edges returned toward web and with (14.3-mm-) wide slotted holes in webs at (51 mm) o.c. Channels made from galvanized steel complying with ASTM A 653/A 653M, structural quality, (Grade 230), with (Z275) coating; (2-mm) nominal thickness.
 - 5. Iron Castings: (ASTM A 47M, Grade 22010) malleable iron or (ASTM A 48M, Class 200) gray iron.
 - Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either (ASTM A 47M)
 malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed,
 hot-dip galvanized per ASTM A 153/A 153M.

2.2 PAINT

- A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664 and compatible with finish paint systems indicated.
- B. Shop Primer for Ferrous Metal: SSPC-Paint 20, organic zinc-rich primer compatible with topcoat.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:

a. Carboline Company; Carboline 621.

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- b. PPG Industries, Inc.; Aquapon Zinc-Rich Primer 97-670.
- c. Tnemec Company, Inc.; Tneme-Zinc 90-97.
- d. Or approved equal.

2.3 MISCELLANEOUS MATERIALS

- A Nonshrink, Nonmetallic Grout: ASTM C 1107, factory-packaged, nonstaining, noncorrosive, nongaseous grout.
- B Concrete Fill: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of (20 MPa), unless otherwise indicated.
- C. Provide aluminum abrasive insert nosing equal to Balco HS-338 at all new exterior concrete stairs.

2.4 FABRICATION

- A. Connections, General: Use connections that maintain structural value of joined pieces.
 - 1. Shear and punch metals cleanly and accurately. Remove burrs.
 - 2. Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.
 - 3. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes.
 - 4. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
- B. Steel Ladders: Comply with ANSI A14.3, unless otherwise indicated.
 - Ladders: Comply with ASME A17.1.
 - 2. Siderails: Continuous, (12-by-64-mm) steel flat bars, with eased edges, spaced (457 mm) apart.
 - 3. Bar Rungs: (19-mm-) diameter steel bars, spaced (300 mm) o.c.
 - a. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
 - 4. Support each ladder at top and bottom and not more than (1500 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.

2.5 FINISHES

- A. Finish metal fabrications after assembly. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Shop prime ferrous-metal items not indicated to be galvanized.
 - 1 Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
 - 2 Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Provide anchorage devices and fasteners for securing metal fabrications to in-place construction. Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true.
 - 1. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
 - 2. Fit exposed connections accurately together. Weld connections, unless otherwise indicated. Do not weld, cut, or abrade galvanized surfaces.

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- B. Set bearing and leveling plates on cleaned surfaces using wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts and pack with nonshrink, nonmetallic grout.
- C Touch up surfaces and finishes after erection.
 - 1. Painted Surfaces: Clean field welds, bolted connections, and abraded areas and touch up paint with the same material as used for shop priming.
 - 2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

METAL FABRICATIONS 055000 - 3

SECTION 06100 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber.
 - 2. Framing with timber.
 - 3. Framing with engineered wood products.
 - 4. Rooftop equipment bases and support curbs.
 - 5. Wood blocking, cants, and nailers
 - 6. Utility shelving.
 - 7. Wood furring and grounds.
 - 8. Sheathing.
 - 9. Subflooring and underlayment.
 - 10. Plywood backing panels.
 - 11. Building wrap.

1.3 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.
- B. Exposed Framing: Dimension lumber not concealed by other construction.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NELMA Northeastern Lumber Manufacturers Association.
 - 2. NLGA National Lumber Grades Authority.
 - RIS Redwood Inspection Service.
 - 4. SPIB Southern Pine Inspection Bureau.
 - 5. WCLIB West Coast Lumber Inspection Bureau.
 - WWPA Western Wood Products Association.

1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
 - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

- B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee Board of Review.
- C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
 - 1. Preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Engineered wood products.
 - Foam-plastic sheathing.
 - 5. Power-driven fasteners.
 - 6. Powder-actuated fasteners.
 - 7. Expansion anchors.
 - 8. Metal framing anchors.
 - 9. Building wrap.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.
- C. Source Limitations for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product through one source from a single producer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - Laminated-Veneer Lumber:
 - a. Boise Cascade Corporation.
 - b. Georgia-Pacific Corporation.
 - c. Louisiana-Pacific Corporation.
 - d. Pacific Woodtech Corp.
 - e. Trus Joist MacMillan.
 - f. Union Camp Corp.; Building Products Division.
 - g. Willamette Industries, Inc.
 - 2. Parallel-Strand Lumber:
 - a. Trus Joist MacMillan.
 - 3. Prefabricated Wood I-Joists:
 - a. Boise Cascade Corporation.
 - b. Georgia-Pacific Corporation.
 - c. Louisiana-Pacific Corporation.
 - d. Pacific Woodtech Corp.
 - e. Poutrelles International Inc.

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- f. Standard Structures Inc.
- g. Stark Truss Company, Inc.
- h. Superior Wood Systems, Inc.
- i. Trus Joist MacMillan.
- j. Union Camp Corp.; Building Products Division.
- k. Willamette Industries, Inc.
- 4. Gypsum Sheathing Board:
 - a. American Gypsum Co.
 - b. G-P Gypsum Corporation.
 - c. National Gypsum Company.
 - d. United States Gypsum Co.
- 5. Extruded-Polystyrene-Foam Wall Sheathing:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. Tenneco Building Products.
- 6. Polyisocyanurate-Foam Wall Sheathing:
 - a. Apache Products Company.
 - b. Celotex Corporation (The); Building Products Division.
 - c. Rmax, Inc.
- 7. Building Wrap:
 - a. Celotex Corporation (The); Building Products Division.
 - b. DuPont (E. I. du Pont de Nemours and Company).
 - c. Parsec, Inc.
 - d. Raven Industries, Inc.
 - e. Reemay, Inc.
 - f. Simplex Products.
 - g. Sto-Cote Products, Inc.
 - h. Tenneco Building Products.
- 8. Metal Framing Anchors:
 - a. Alpine Engineered Products, Inc.
 - b. Cleveland Steel Specialty Co.
 - c. Harlen Metal Products, Inc.
 - d. KC Metals Products, Inc.
 - e. Silver Metal Products. Inc.
 - f. Simpson Strong-Tie Company, Inc.
 - g. Southeastern Metals Manufacturing Co., Inc.
 - h. United Steel Products Company, Inc.

2.2 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 4. Provide dressed lumber, S4S, unless otherwise indicated.
 - 5. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
- B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

 Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Wood Structural Panels:

- 1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
- 2. Oriented Strand Board: DOC PS 2.
- Thickness: As needed to comply with requirements specified but not less than thickness indicated.
- 4. Comply with "Code Plus" provisions in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."
- 5. Factory mark panels according to indicated standard.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and the following:
 - a. Chromated copper arsenate (CCA).
 - b. Ammoniacal copper zinc arsenate (ACZA).
 - c. Ammoniacal, or amine, copper quat (ACQ).
 - d. Copper bis (dimethyldithiocarbamate) (CDDC).
 - e. Ammoniacal copper citrate (CC).
 - f. Copper azole, Type A (CBA-A).
 - g. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.
 - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece, or omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing members less than 18 inches above grade.
 - 4. Wood floor plates that are installed over concrete slabs directly in contact with earth.

2.4 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

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- 1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
- 2. Use treatment that does not promote corrosion of metal fasteners.
- 3. Use Exterior type for exterior locations and where indicated.
- 4. Use Interior Type A High Temperature (HT), unless otherwise indicated.
- B. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

2.5 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.
- B. Non-Load-Bearing Interior Partitions: Construction, Stud, or No. 2 grade and the following species:
 - Mixed southern pine; SPIB.
 - 2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
 - 3. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
 - 4. Eastern softwoods; NELMA.
 - 5. Northern species; NLGA.
 - 6. Western woods; WCLIB or WWPA.
- C. Framing Other Than Non-Load-Bearing Partitions: Construction, Stud, or No. 2 grade and any of the following species:
 - 1. Douglas fir-larch; WCLIB or WWPA.
 - 2. Douglas fir-south; WWPA.
 - 3. Douglas fir-larch (north); NLGA.
 - 4. Hem-fir; WCLIB or WWPA.
 - 5. Hem-fir (north); NLGA.
 - 6. Southern pine: SPIB.
 - 7. Mixed southern pine; SPIB.
 - 8. Spruce-pine-fir (south); NELMA, WCLIB, or WWPA.
 - 9. Spruce-pine-fir; NLGA.
- D. Ceiling Joists (Non-Load-Bearing): Construction, Stud, or No. 2 grade and any of the following species:
 - 1. Douglas fir-larch; WCLIB or WWPA.
 - 2. Douglas fir-south; WWPA.
 - 3. Douglas fir-larch (north); NLGA.
 - 4. Hem-fir; WCLIB or WWPA.
 - 5. Hem-fir (north): NLGA.
 - 6. Southern pine; SPIB.
 - 7. Mixed southern pine; SPIB.
 - 8. Spruce-pine-fir (south); NELMA, WCLIB, or WWPA.
 - 9. Spruce-pine-fir; NLGA.
- E. Joists, Rafters, and Other Framing Not Listed Above: Construction or No. 2 grade and any of the following species:
 - 1. Douglas fir-larch; WCLIB or WWPA.
 - 2. Douglas fir-south: WWPA.
 - 3. Douglas fir-larch (north); NLGA.
 - 4. Hem-fir; WCLIB or WWPA.
 - 5. Hem-fir (north); NLGA.
 - 6. Southern pine; SPIB.
 - 7. Spruce-pine-fir (south); NELMA, WCLIB, or WWPA.
 - 8. Spruce-pine-fir; NLGA.

- F. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics that would impair finish appearance.
 - 1. Species and Grade: As indicated above for load-bearing construction of same type.
 - 2. Species and Grade: Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; Select Structural or No. 1 grade; NLGA, WCLIB, or WWPA.
 - 3. Species and Grade: Eastern hemlock-balsam fir or Eastern hemlock-tamarack; Select Structural or No. 1 grade; NELMA.
 - Species and Grade: Hem-fir or Hem-fir (north), Select Structural grade; NLGA, WCLIB, or WWPA.
 - 5. Species and Grade: Mixed maple, Select Structural grade; NELMA.
 - 6. Species and Grade: Mixed oak, Select Structural grade; NELMA.
 - 7. Species and Grade: Redwood, Clear Heart Structural or Clear Structural or Select Structural grade; RIS.
 - 8. Species and Grade: Southern pine, Select Structural or No. 1 grade; SPIB.
 - 9. Species and Grade: Spruce-pine-fir or Spruce-pine-fir (south), Select Structural or No. 1 grade; NELMA, NLGA, WCLIB, or WWPA.

2.6 TIMBER

- A. For timber of 5-inch nominal size and thicker, provide material complying with the following requirements:
 - 1. Species and Grade: Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; **Select Structural** or **No. 1** grade; NLGA, WCLIB, or WWPA.
 - 2. Species and Grade: Eastern hemlock, Eastern hemlock-tamarack, or Eastern hemlock-tamarack (north); **Select Structural** or **No. 1** grade; NELMA or NLGA.
 - 3. Species and Grade: Hem-fir or Hem-fir (north), Select Structural or No. 1 grade; NLGA, WCLIB. or WWPA.
 - 4. Species and Grade: Mixed maple, Select Structural or No. 1 grade; NELMA.
 - 5. Species and Grade: Mixed oak, Select Structural or No. 1 grade; NELMA.
 - 6. Species and Grade: Southern pine, Select Structural or No. 1 grade; SPIB.
 - 7. Additional Restriction: Free of heart centers.

2.7 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including the following:
 - 1. Rooftop equipment bases and support curbs.
 - 2. Blocking.
 - 3. Cants.
 - 4. Nailers.
 - 5. Furring.
 - 6. Grounds.
- B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:
 - 1. Mixed southern pine; SPIB.
 - 2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
 - 3. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
 - Eastern softwoods; NELMA.
 - 5. Northern species; NLGA.
 - 6. Western woods; WCLIB or WWPA.
- C. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.8 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: A composite of wood veneers with grain primarily parallel to member lengths, manufactured with an exterior-type adhesive complying with ASTM D 2559. Product has the following minimum allowable design values as determined according to ASTM D 5456:
 - 1. Extreme Fiber Stress in Bending, Edgewise: 2500 psi for 12-inch nominal- depth members.
 - 2. Modulus of Elasticity, Edgewise: 1,800,000 psi.
- B. Wood I-Joists: Prefabricated units complying with APA PRI-400; depths and performance ratings not less than those indicated.
 - 1. Web Material: Plywood, Exterior grade.
 - 2. Structural Capacities: Establish and monitor structural capacities according to ASTM D 5055.
 - 3. Trademark: Factory mark I-joists with APA trademark indicating nominal joist depth, joist class, span ratings, mill identification, and I-joist compliance with APA standard.

2.9 SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural I sheathing.
 - 1. Span Rating: Not less than 16/0.
 - 2. Thickness: Not less than 3/8 inch.
- B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I [Exposure 1] sheathing.
 - 1. Span Rating: Not less than 16/0.
 - 2. Thickness: Not less than 3/8 inch.
- C. Paper-Surfaced Gypsum Wall Sheathing: ASTM C 79/C 79M, with water-resistant material incorporated into the core and with water-repellent paper bonded to core's face, back, and long edges.
 - 1. Type and Thickness: Regular, 1/2 inch thick or as noted on plans.
- D. Plywood Roof Sheathing: Exterior, Structural I sheathing.
 - 1. Span Rating: Not less than 16/0.
 - 2. Thickness: Not less than 1/2 inch.

2.10 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exterior, Structural I, C-C Plugged single-floor panels.
 - 1. Span Rating: Not less than 16 oc.
 - 2. Thickness: Not less than 7/8 inch.
 - 3. Edge Detail: Square.
 - 4. Edge Detail: Tongue and groove.
 - 5. Surface Finish: Fully sanded face.
- B. Plywood Subflooring: Exterior, Structural I single-floor panels or sheathing.
 - Span Rating: Not less than 16 oc or 32/16.
 - 2. Thickness: Not less than 7/8 inch.
- C. Underlayment, General: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch over smooth subfloors and not less than 3/8 inch over board or uneven subfloors.
- D. Particleboard Underlayment: ANSI A208.1, Grade PBU.
- E. Hardboard Underlayment: AHA A135.4, Class 4 (Service), Surface S1S; with back side sanded.

2.11 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch thick.

2.12 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.13 METAL FRAMING ANCHORS

- A. General: Provide framing anchors made from metal indicated, of structural capacity, type, and size indicated, and as follows:
 - 1. Research/Evaluation Reports: Provide products acceptable to authorities having jurisdiction and for which model code research/evaluation reports exist that show compliance of metal framing anchors, for application indicated, with building code in effect for Project.
 - 2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
- C. Stainless-Steel Sheet: ASTM A 666, Type 316.
 - 1. Use for exterior locations and where indicated.
- D. Joist Hangers: U-shaped joist hangers with 2-inch- long seat and 1-1/4-inch- wide nailing flanges at least 85 percent of joist depth.
 - 1. Thickness: 0.062 inch.

- E. I-Joist Hangers: U-shaped joist hangers with 2-inch- long seat and 1-1/4-inch- wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.
 - 1. Thickness: 0.062 inch.
- F. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
 - 1. Strap Width: 2 inches.
 - 2. Thickness: 0.062 inch.
- G. Bridging: Rigid, V-section, nailless type, 0.062 inch thick, length to suit joist size and spacing.
- H. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch- minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.
- I. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
 - 1. Width: 1-1/4 inches.
 - 2. Thickness: 0.062 inch.
 - 3. Length: 24 inches.
- J. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick.
- K. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches wide by 0.062 inch thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.
- L. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches wide by 0.050 inch thick by 36 inches long.
- M. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.
 - 1. Bolt Diameter: 3/4 inch.
 - 2. Width: 3-3/16 inches.
 - 3. Body Thickness: 0.138 inch.
 - Base Reinforcement Thickness: 0.239 inch.
- N. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches wide by 9/16 inch deep by 0.034 inch thick with hemmed edges.
- O. Wall Bracing: Angle bracing made for letting into studs in saw kerf, 15/16 by 15/16 by 0.040 inch thick with hemmed edges.

2.14 MISCELLANEOUS MATERIALS

- A. Building Paper: Asphalt-saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), unperforated.
- B. Building Wrap: Air-retarder sheeting made from polyolefins; cross-laminated films, woven strands, or spun-bonded fibers; coated or uncoated; with or without perforations; and complying with ASTM E 1677, Type I.
 - 1. Thickness: Not less than 3 mils.
 - 2. Permeance: Not less than 10 perms.
 - 3. Flame-Spread Index: 25 or less per ASTM E 84.
 - 4. Allowable Exposure Time: Not less than three months.

- C. Building Wrap Tape: Pressure-sensitive plastic tape recommended by building wrap manufacturer for sealing joints and penetrations in building wrap.
- D. Sheathing Tape: Pressure-sensitive plastic tape for sealing joints and penetrations in sheathing and recommended by sheathing manufacturer for use with type of sheathing required.
- E. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.
- F. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- G. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturers.
- H. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. CABO NER-272 for power-driven fasteners.
 - 2. Published requirements of metal framing anchor manufacturer.
 - 3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in the Uniform Building Code.
 - 4. Table 2305.2, "Fastening Schedule," in the BOCA National Building Code.
 - 5. Table 2306.1, "Fastening Schedule," in the Standard Building Code.
 - 6. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in the International One- and Two-Family Dwelling Code.
- E. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.
- F. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

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3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
 - 1. Fire block furred spaces of walls, at each floor level and at ceiling, with wood blocking or noncombustible materials accurately fitted to close furred spaces.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring vertically at 24 inches o.c.
- C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.
- D. Furring to Receive Plaster Lath: Install 1-by-2-inch nominal size furring vertically at 16 inches o.c.

3.4 WOOD FRAMING INSTALLATION, GENERAL

- A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Do not splice structural members between supports.
- D. Where built-up beams or girders of 2-inch nominal dimension lumber on edge are required, fasten together with 2 rows of 20d nails spaced not less than 32 inches o.c. Locate one row near top edge and other near bottom edge.

3.5 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Arrange studs so wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Anchor or nail plates to supporting construction, unless otherwise indicated.
 - 1. For exterior walls, provide 2-by-4-inch nominal size wood studs spaced 16 inches o.c., unless otherwise indicated.
 - 2. For interior partitions and walls, provide 2-by-4-inch nominal size wood studs spaced 16 inches o.c., unless otherwise indicated.
- B. Construct corners and intersections with three or more studs. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

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- 1. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.
- C. Fire block concealed spaces of wood-framed walls and partitions at each floor level and at ceiling line of top story. Where fire blocking is not inherent in framing system used, provide closely fitted wood blocks of 2-inch nominal thick lumber of same width as framing members.
- D. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.
 - 1. For non-load-bearing partitions, provide double-jamb studs with headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
 - 2. For load-bearing walls, provide double-jamb studs for openings 72 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated or, if not indicated, according to Table 602.7 in the International One- and Two-Family Dwelling Code.
- E. Provide bracing in exterior walls, at both walls of each external corner, full-story height, unless otherwise indicated. Provide one of the following:
- F. Provide bracing in walls, at locations indicated, full-story height, unless otherwise indicated. Provide one of the following:
 - 1. Diagonal bracing at 45-degree angle using let-in 1-by-4-inch nominal- size boards.
 - 2. Diagonal bracing at 45-degree angle using metal bracing.
 - 3. Plywood panels not less than 48 by 96 inches applied vertically.
 - 4. Oriented-strand-board panels not less than 48 by 96 inches applied vertically.
 - 5. Particleboard sheathing panels not less than 48 by 96 inches applied vertically.
 - 6. In lieu of bracing at corners or at locations indicated, continuous gypsum sheathing may be provided in panels not less than 48 by 96 inches applied vertically.
 - 7. In lieu of bracing at corners or at locations indicated, continuous fiberboard sheathing, intermediate type, may be provided in panels not less than 48 by 96 inches applied vertically.

3.6 FLOOR JOIST FRAMING INSTALLATION

- A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:
 - 1. Where supported on wood members, by using metal framing anchors.
 - 2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.
- B. Fire Cuts: At joists built into masonry, bevel cut ends 3 inches and do not embed more than 4 inches.
- C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches.
- D. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than 2 inches from top or bottom.
- E. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.
- F. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches or securely tie opposing members together. Provide solid blocking of 2-inch nominal thickness by depth of joist over supports.

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- G. Anchor members paralleling masonry with 1/4-by-1-1/4-inch metal strap anchors spaced not more than 96 inches o.c., extending over and fastening to 3 joists. Embed anchors at least 4 inches into grouted masonry with ends bent at right angles and extending 4 inches beyond bend.
- H. Provide solid blocking between joists under jamb studs for openings.
- Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.
 - 1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.
- J. Provide bridging of type indicated below, at intervals of 96 inches o.c., between joists.
 - 1. Diagonal wood bridging formed from bevel-cut, 1-by-3-inch nominal- size lumber, double-crossed and nailed at both ends to joists.
 - 2. Steel bridging installed to comply with bridging manufacturer's written instructions.
 - 3. Bridging may be omitted where joist depth is 12-inch nominal size or less and where indicated live load is 40 lbf/sq. ft. or less.

3.7 CEILING JOIST AND RAFTER FRAMING INSTALLATION

- A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
 - 1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- size or 2-by-4-inch nominal-size stringers spaced 48 inches o.c. crosswise over main ceiling joists.
- B. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
 - 1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.
 - 2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.
- C. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal- size boards between every third pair of rafters, but not more than 48 inches o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.
- D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions, if any.

3.8 TIMBER FRAMING INSTALLATION

- A. Install timber with crown edge up and provide not less than 4 inches of bearing on supports. Provide continuous members, unless otherwise indicated; tie together over supports if not continuous.
- B. Where beams or girders are framed into pockets of exterior concrete or masonry walls, provide 1/2-inch air space at sides and ends of wood members.
- C. Install wood posts using metal anchors indicated.
- D. Treat ends of timber beams and posts exposed to weather by dipping in water-repellent preservative for 15 minutes.

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3.9 STAIR FRAMING INSTALLATION

- A. Provide stair framing members of size, space, and configuration indicated or, if not indicated, to comply with the following requirements:
 - 1. Stringer Size: 2-by-12-inch nominal- size, minimum.
 - 2. Notching: Notch stringers to receive treads, risers, and supports; leave at least 3-1/2 inches of effective depth.
 - 3. Stringer Spacing: At least 3 stringers for each 36-inch clear width of stair.
- B. Provide stair framing with no more than 3/16-inch variation between adjacent treads and risers and no more than 3/8-inch variation between largest and smallest treads and risers within each flight.

3.10 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
 - 1. Comply with "Code Plus" provisions in above-referenced guide.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Combination Subfloor-Underlayment:
 - a. Nail to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch apart at edges and ends.
 - 2. Subflooring:
 - a. Nail or staple to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch apart at edges and ends.
 - 3. Sheathing:
 - a. Nail or staple to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch apart at edges and ends.
 - 4. Underlayment:
 - a. Nail or staple to subflooring.
 - b. Space panels 1/32 inches apart at edges and ends.
 - c. Fill and sand edge joints of underlayment receiving resilient flooring just before installing flooring.
 - 5. Plywood Backing Panels: Nail or screw to supports.

3.11 PARTICLEBOARD UNDERLAYMENT INSTALLATION

- A. Comply with the National Particleboard Association's recommendations for the type of subfloor indicated. Fill and sand gouges, gaps, and chipped edges. Sand uneven joints flush.
 - 1. Fastening Method: Nail or staple underlayment to subflooring.

3.12 HARDBOARD UNDERLAYMENT

- A. Comply with AHA's "Application Instructions for Basic Hardboard Products" and hardboard manufacturer's written instructions for preparing and applying hardboard underlayment.
 - 1. Fastening Method: Nail or staple underlayment to subflooring.

3.13 FOAM-PLASTIC SHEATHING INSTALLATION

A. Comply with manufacturer's written instructions for applying sheathing. Install vapor-relief strips or equivalent for permitting escape of moisture vapor that otherwise would be trapped in stud cavity behind sheathing.

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3.14 GYPSUM SHEATHING

- A. General: Fasten gypsum sheathing to supports with galvanized roofing nails or divergent point galvanized staples; comply with GA-253 and manufacturer's recommended spacing and referenced fastening schedule. Keep perimeter fasteners 3/8 inch from edges and ends of units.
- B. Install 24-by-96-inch sheathing horizontally with long edges at right angles to studs with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent board without forcing. Abut ends of boards over centers of studs and stagger end joints of adjacent boards not less than one stud spacing, two where possible.
- C. Install 48-by-96-inch and longer sheathing vertically with long edges parallel to, and centered over, studs. Install solid wood blocking where end joints do not occur over framing. Fit units tightly against each other.

3.15 FIBERBOARD SHEATHING INSTALLATION

- A. Fasten fiberboard sheathing panels to intermediate supports and then at edges and ends. Use galvanized roofing nails or galvanized staples; comply with manufacturer's recommended spacing and referenced fastening schedule. Drive fasteners flush with surface of sheathing and locate perimeter fasteners at least 3/8 inch from edges and ends.
- B. Install sheathing vertically with long edges parallel to, and centered over, studs. Install solid wood blocking where end joints do not occur over framing. Allow 1/8-inch open space between edges and ends of adjacent units. Stagger horizontal joints, if any.
- C. Cover sheathing as soon as practical after installation to prevent deterioration from wetting.

3.16 BUILDING PAPER APPLICATION

A. Apply building paper horizontally with 2-inch overlap and 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails. Cover upstanding flashing with 4-inch overlap.

3.17 BUILDING WRAP APPLICATION

- A. Cover wall sheathing with building wrap as indicated.
 - 1. Comply with manufacturer's written instructions.
 - 2. Cover upstanding flashing with 4-inch overlap.
 - 3. Seal seams, edges, and penetrations with tape.
 - 4. Extend into jambs of openings and seal corners with tape.

3.18 SHEATHING TAPE APPLICATION

A. Apply sheathing tape to joints between sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

END OF SECTION 061000

SECTION 061050 - MISCELLANEOUS CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Wood furring, grounds, nailers, and blocking.
 - 2. Sheathing.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:
 - 1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
 - 2. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.
 - 3. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.
- C. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with performance requirements indicated.
- D. Warranty of chemical treatment manufacturer for each type of treatment.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.
 - 1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

- A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
 - 1. NELMA Northeastern Lumber Manufacturers Association.
 - 2. NLGA National Lumber Grades Authority (Canadian).
 - 3. SPIB Southern Pine Inspection Bureau.

- 4. WCLIB West Coast Lumber Inspection Bureau.
- 5. WWPA Western Wood Products Association.
- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
- D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 1. Provide dressed lumber, S4S, unless otherwise indicated.
 - 2. Provide lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
 - 1. Do not use chemicals containing chromium or arsenic.
- B. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. (4.0 kg/cu. m). After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing members less than 18 inches (460 mm) above grade.
- C. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft. (6.4 kg/cu. m).

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated wood is indicated, comply with applicable requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL; U.S. Testing; Timber Products Inspection, Inc.; or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Treatment Type: Interior Type A.
 - 2. Treatment Type: Exterior.
 - 3. Treatment Types: Interior Type A for protected wood and Exterior for wood exposed to weather.
- B. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

2.4 BOARDS

- A. Exposed Boards: Where boards will be exposed in the finished work, provide the following:
 - 1. Moisture Content: 15 percent maximum.
 - 2. Species and Grade: Eastern white pine, D Select per NELMA or NLGA rules.
 - 3. Species and Grade: Southern pine, C Finish per SPIB rules.
 - 4. Species and Grade: Hem-fir, C & Btr per WCLIB rules or C Select per NLGA or WWPA rules.
 - 5. Species and Grade: Spruce-pine-fir, C & Btr per WCLIB rules or C Select per NLGA or WWPA rules.
 - 6. Species and Grade: Western or Idaho white pine, Choice per NLGA or WWPA rules.
 - 7. Species and Grade: Any species above.

- B. Concealed Boards: Where boards will be concealed by other work, provide lumber with 19 percent maximum moisture content and of following species and grade:
 - 1. Species and Grade: Eastern softwoods, No. 3 Common per NELMA rules.
 - 2. Species and Grade: Northern species, No. 3 Common or Standard per NLGA rules.
 - 3. Species and Grade: Mixed southern pine, No. 2 per SPIB rules.
 - 4. Species and Grade: Hem-fir, Standard per WCLIB rules or No. 3 Common per WWPA rules.
 - 5. Species and Grade: Spruce-pine-fir, Standard per WCLIB rules or No. 3 Common per WWPA rules.
 - 6. Species and Grade: Western woods, Standard per WCLIB rules or No. 3 Common per WWPA rules.
 - 7. Species and Grade: Any species above.

2.5 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture Content: 15 percent maximum for lumber items are not specified to receive wood preservative treatment.
- D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

2.6 ARTICLEBOARD

A. General: Comply with and factory mark each panel according to ANSI A208.1. Provide thickness indicated.

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where miscellaneous carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.9 METAL FRAMING ANCHORS

- A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and acceptable to authorities having jurisdiction.
- B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 (ASTM A 653M, Z180) coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- C. Fit carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.
- E. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
- F. Countersink nail heads on exposed carpentry work and fill holes with wood filler.
- G. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.
- 3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS
 - A. Install where shown and where required for screeding or attaching other work. Cut and shape to required size. Coordinate locations with other work involved.
 - B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WOOD FURRING

- A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring at 16 inches (406 mm) o.c., vertically.

END OF SECTION 061050

SECTION 064020 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim.
 - 2. Laminate-clad cabinets (plastic-covered casework).
 - 3. Plastic-laminate countertops.
 - 4. Wood paneling.
 - 5. Interior ornamental work.
 - 6. Shop finishing of woodwork.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction prior to woodwork installation.
- B. Rough carriages for stairs are a part of interior architectural woodwork. Platform framing, headers, partition framing, and other rough framing associated with stairwork are specified in Division 6 Section "Rough Carpentry."

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of product and process specified and incorporated into items of architectural woodwork during fabrication, finishing, and installation.
- C. Fire-retardant-treatment data for material treated to reduce combustibility. Include certification by treating plant that treated materials comply with requirements.
- D. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcing specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.
 - 4. Show veneer leaves with dimensions, grain direction, exposed face, and an identification number indicated for each leaf. Identification number shall indicate the flitch and the sequence within the flitch for each leaf.
 - 5. Apply WIC Certified Compliance Label to first page of shop drawings.
- E. Samples for initial selection of the following in the form of manufacturer's color charts consisting of actual units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.
 - 1. Shop-applied transparent finishes.
 - 2. Shop-applied opaque finishes.
 - 3. Plastic laminates.
 - 4. Thermoset decorative overlays.

5. Solid surfacing materials.

F. Samples for verification of the following:

- 1. Lumber with or for transparent finish, 50 sq. in. (300 sq. cm), for each species and cut, finished on one side and one edge.
- 2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
- 3. Wood-veneer-faced panel products, with or for transparent finish, 8 by 10 inches (200 by 250 mm), for each species and cut. Include at least one face-veneer seam and finish one-half of face as specified.
- a. Step finish materials on sample to show and clearly define each coat.
- b. Provide separate samples of unfaced panel product used for core.
- 4. Lumber and panel products with shop-applied opaque finish, 8 by 10 inches (200 by 250 mm) for panels and 50 sq. in. (300 sq. cm) for lumber, for each finish system and color, with one-half of exposed surface finished.
- 5. Laminate-clad panel products, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
- 6. Thermoset decorative-overlay surfaced panel products, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
- 7. Solid surfacing materials, 6 inches (150 mm) square.
- 8. Corner pieces as follows:
 - a. Cabinet front frame joints between stiles and rail, as well as exposed end pieces, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.
 - b. Miter joints for standing trim.
- 9. Exposed cabinet hardware, one unit for each type and finish.
- G. Product certificates signed by woodwork fabricator certifying that products comply with specified requirements.
- H. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work.
- B. Installer Qualifications: Arrange for interior architectural woodwork installation by a firm that can demonstrate successful experience in installing architectural woodwork items similar in type and quality to those required for this Project.
- C. Single-Source Responsibility: Arrange for production of interior architectural woodwork with sequence-matched wood veneers by a single firm.
 - 1. Include the veneering of wood doors in the single-firm production where veneer matching extends across wood doors.
- D. Single-Source Responsibility for Fabrication and Installation: Engage a qualified woodworking firm to assume undivided responsibility for fabricating, finishing, and installing woodwork specified in this Section.
- E. Quality Standard: Except as otherwise indicated, comply with the following standard:
 - 1. AWI Quality Standard: "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute for grades of interior architectural woodwork, construction, finishes, and other requirements.

- a. Provide AWI Certification Labels or Certificates of Compliance indicating that woodwork meets requirements of grades specified.
- F. Fire-Test-Response Characteristics: Provide materials with the following fire-test-response characteristics as determined by testing identical products per ASTM test method indicated below by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify fire-retardant-treated material with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
 - 1. Surface-Burning Characteristics: Not exceeding values indicated below, tested per ASTM E 84 for standard time period (10 minutes).
 - a. Flame Spread: 75.
 - b. Smoke Developed: 450.
- 2. Surface-Burning Characteristics: Not exceeding values indicated below, tested per ASTM E 84 for 30 minutes with no evidence of significant combustion. In addition, the flame front shall not progress more than 10-1/2 feet (3.2 m) beyond the center line of the burner at any time during the test.
 - a. Flame Spread: 25.
 - b. Smoke Developed: 450.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
- B. Do not deliver woodwork until painting and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet-work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Obtain and comply with woodwork fabricator's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork will be within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.
- C. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Verify locations of concealed framing, blocking, reinforcements, and furring that support woodwork by accurate field measurements before being enclosed. Record measurements on final shop drawings.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated. B. Hardware Coordination: Distribute copies of approved schedule for cabinet hardware specified in Division 8 Section "Door Hardware" to fabricator of architectural woodwork; coordinate cabinet shop drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

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

2.2 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade indicated and, where the following products are part of interior woodwork, with requirements of the referenced product standards that apply to product characteristics indicated:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2.
 - 3. Particleboard: ANSI A208.1, Grade M-2.
 - 4. Softwood Plywood: PS 1.
 - 5. Hardwood Plywood and Face Veneers: HPVA HP-1.
- B. Formaldehyde Emission Level for Medium-Density Fiberboard: Comply with requirements of NPA 9.
- C. Fiberboard: Medium-density fiberboard made without formaldehyde and complying with ANSI A208.2.
 - 1. Product: Subject to compliance with requirements, provide Medite II by Medite Corp.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering highpressure decorative laminates that may be incorporated in the Work include, but are not limited to, the following:
 - a. Formica Corporation.
 - b. Laminart.
 - c. Nevamar Corp.
 - d. Pioneer Plastics Corp.
 - e. Westinghouse Electric Corp.; Specialty Products Div.
 - f. Ralph Wilson Plastics Co.
- E. Chemical-Resistant, High-Pressure Decorative Laminate: NEMA LD 3, Grade PF-42, and as follows:
 - 1. Laminate has the following ratings when tested with indicated reagents according to NEMA LD 3 test procedure 3.9.5:
 - a. Nitric acid (30 percent): moderate effect.
 - b. Sulfuric acid (77 percent): moderate effect.
 - c. Hydrochloric acid (37 percent): moderate effect.
 - d. Phosphoric acid (75 percent): no effect.
 - e. Acetic acid (98 percent): no effect.
 - f. Carbon tetrachloride: no effect.
 - g. Formaldehyde: no effect.
 - h. Ethyl acetate: no effect.
 - i. Ethyl ether: no effect.
 - j. Phenol (85 percent): moderate effect.
 - k. Benzene: no effect.
 - I. Xylene: no effect.
 - m. Butyl alcohol: no effect.
 - n. Furfural: no effect.

- o. Methyl ethyl ketone: no effect.
- p. Sodium hydroxide (25 percent): no effect.
- q. Sodium sulfide (15 percent): no effect.
- r. Ammonium hydroxide (28 percent): no effect.
- s. Zinc chloride: no effect.
- t. Gentian violet: no effect.
- u. Methyl red: no effect.
- 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Lab Grade 840 Black; Formica Corporation.
 - b. Pionite Chemquard; Pioneer Plastics Corp.
 - c. Chemsurf; Ralph Wilson Plastics Co.
- F. Thermoset Decorative Overlay: Decorative surface of thermally fused polyester or melamine-impregnated web, bonded to specified substrate and complying with ALA 1992.
 - 1. Substrate: Fire-retardant particleboard.
- G. Solid Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with the material and performance requirements of ANSI Z124.3, Type 5 or Type 6, without a precoated finish.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Avonite; Avonite, Inc.
 - b. Corian; DuPont Polymers.
 - c. Surell; Formica Corp.
 - d. Fountainhead; Nevamar Corp.
 - e. Swanstone; The Swan Corporation.
 - f. Gibraltar; Ralph Wilson Plastics Co.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where indicated, use materials impregnated with fire-retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire-test-response characteristics specified.
- B. Fire-Retardant Chemicals: Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
- C. Fire-Retardant-Treated Lumber: Comply with the following:
 - 1. Organic-Resin-Based Formulation: Exterior type per AWPA C20, consisting of organic-resin solution, relatively insoluble in water, thermally set in wood by kiln drying.
 - 2. Low-Hygroscopic Formulation: Interior Type A per AWPA C20.
 - 3. Nonpressure-Treatment Formulation: Nontoxic, water-soluble product applied by dip, spray, roller, curtain coating, vacuum chamber, or soaking.
 - 4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
 - 5. Kiln-dry material before and after treatment to levels required for untreated material.
 - 6. Discard treated material that does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective material.
 - 7. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Organic-Resin-Based Formulation (Exterior Type):
 - 1) Exterior Fire-X; American Wood Treaters, Inc.
 - 2) Exterior Fire-X; Hoover Treated Wood Products, Inc.
 - b. Low-Hygroscopic Formulation (Type A):
 - 1) D-Blaze; J. H. Baxter Co.

- 2) D-Blaze; Chemical Specialties, Inc.
- 3) Pyro-guard; Continental Wood Preservers, Inc.
- 4) Dricon; Hickson Corp.
- 5) Pyro-guard; Hoover Treated Wood Products, Inc.
- c. Nonpressure-Treatment Formulation:
 - 1) Gaia Process; Fibretech, Inc.
- D. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve products identical to those tested for flame spread of 25 or less and for smoke developed of 25 or less per ASTM E 84 by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting agency.
 - For panels 3/4 inch (19 mm) thick and less and 45-lb/cu. ft (720-kg/cu. m) density, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2000 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 lbf (1100 N) and 225 lbf (1000 N) respectively.
 - For panels 13/16 to 1-1/4 inches (20 to 32 mm) thick and 44-lb/cu. ft (705-kg/cu. m) density, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi (9 MPa); modulus of elasticity, 250,000 psi (1700 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 lbf (1100 N) and 175 lbf (780 N) respectively.
 - 3. Product: Subject to compliance with requirements, provide Duraflake FR by Willamette Industries, Inc.
- E. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve products identical to those tested for flame spread of 25 or less and for smoke developed of 200 or less per ASTM E 84 by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting agency.
 - 1. Product: Subject to compliance with requirements, provide Medite FR by Medite Corp.

2.4 CABINET HARDWARE AND ACCESSORY MATERIALS

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware."
- B. Cabinet Hardware Schedule: Refer to schedule at end of this Section for cabinet hardware required for architectural cabinets.
- C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA code number indicated.
 - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
- D. For concealed hardware provide manufacturer's standard finish that complies with product class requirements of BHMA A156.9.
- E. Clear Float Glass for Doors: ASTM C 1036, Type I, Class 1, Quality q3, 6 mm thick, unless otherwise indicated.
- F. Clear, Tempered Float Glass for Shelves: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality q3; with exposed edges seamed before tempering, ¼" thick, unless otherwise indicated.

2.5 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

- B. Rough Carriages for Stairs: Comply with requirements of Division 6 Section "Rough Carpentry" for structural framing lumber. Kiln dry to less than 15 percent moisture content.
- C. Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1 for applicable requirements.
 - 1. For metal framing supports, provide screws as recommended by metal-framing manufacturer.
- D. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.
- E. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

2.6 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide interior woodwork complying with the referenced quality standard and of the following grade:
 - 1. Grade: Premium.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to relative humidity conditions existing during time of fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of cabinets and edges of solid-wood (lumber) members 3/4 inch (19 mm) thick or less: 1/16 inch (1.5 mm).
 - 2. Edges of rails and similar members more than 3/4 inch (19 mm) thick: 1/8 inch (3 mm).
- E. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - Trial fit assemblies at the fabrication shop that cannot be shipped completely assembled. Install
 dowels, screws, bolted connectors, and other fastening devices that can be removed after trial
 fitting. Verify that various parts fit as intended and check measurements of assemblies against
 field measurements indicated on approved shop drawings before disassembling for shipment.
- F. Shop-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.
- G. Install glass to comply with applicable requirements of Division 8 Section "Glazing" and of FGMA "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.7 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 300.
 - 1. Grade: Premium.
- B. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- C. Assemble casings in plant except where limitations of access to place of installation require field

assembly.

D. Wood Species: White oak, rift sawn.

2.8 LAMINATE-CLAD CABINETS (PLASTIC-COVERED CASEWORK)

- A. Quality Standard: Comply with AWI Section 400 requirements for laminate-clad cabinets.
 - 1. Grade: Custom.
- B. AWI Type of Cabinet Construction: As indicated.
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other than Tops: GP-50, 0.050-inch (1.270-mm) nominal thickness.
 - 2. Postformed Surfaces: PF-42, 0.042-inch (1.067-mm) nominal thickness.
 - 3. Vertical Surfaces: GP-50, 0.050-inch (1.270-mm) nominal thickness.
 - 4. Edges: GP-50, 0.050-inch (1.270-mm) nominal thickness.
- D. Materials for Semiexposed Surfaces: Provide surface materials indicated below:
 - 1. Surfaces Other than Drawer Bodies: High-pressure decorative laminate, Grade GP-28.
 - 2. Drawer Bottoms: Thermoset decorative overlay.
- E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. Provide Architect's selections from laminate manufacturer's full range of colors and finishes in the following categories:
 - a. Solid colors.
 - b. Solid colors, with core same color as surface.
 - c. Wood grains.
 - d. Patterns.
- F. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers except where located directly under tops.

2.9 COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for countertops.
- B. Type of Top: High-pressure decorative laminate complying with the following:
 - 1. Grade: GP-50, 0.050-inch (1.270-mm) nominal thickness.
 - 2. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - a. Match Architect's sample.
 - b. Match color, pattern, and finish indicated by reference to manufacturer's standard designations for these characteristics.
 - c. Provide Architect's selections from manufacturer's full range of colors and finishes in the following categories:
 - 1) Solid colors.
 - 2) Solid colors, with core same color as surface.
 - 3) Patterns.
 - 3. Grain Direction: Parallel to cabinet fronts.
 - 4. Edge Treatment: Same as laminate cladding on horizontal surfaces.
 - 5. Core Material: Fire-retardant particleboard.

2.10 FLUSH WOOD PANELING AND WAINSCOTS FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 500 requirements for flush wood paneling.
 - 1. Grade: Premium.

- B. Wood Species: White oak, rift cut.
- C. Wood Species: As indicated.
 - 1. Lumber Trim and Edges: At panelwork fabricator's option, trim and edges indicated as solid wood (except moldings) may be either lumber or veneered construction compatible with grain and color of veneered panels.
- D. Panel-Matching Method: No matching between panels is required. Select panels for similarity of grain pattern and color, and arrange sequence of panels for optimum color and grain matching between adjacent panels.
- E. Fire-Test-Response Characteristics: Provide panels composed of wood veneer and fire-retardant particleboard that are identical in construction to units tested for the following surface-burning characteristics per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify panels with appropriate markings of applicable testing and inspecting agency on surfaces that will be concealed from view after installation.
 - 1. Flame Spread: 75 or less.
 - 2. Smoke Developed: 450 or less.
- F. Wood stain color and finish coat of wood paneling to match wood doors reference Division 8 "Flush Wood Panels".

2.11 INTERIOR ORNAMENTAL WORK FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 700.
 - 1. Grade: Premium.
- B. Wood Species: White oak, rift sawn.
- C. Wood Species: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building, unless otherwise indicated.

2.12 SHOP FINISHING OF INTERIOR ARCHITECTURAL WOODWORK

- A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.
 - 1. Grade: Provide finishes of same grades as items to be finished.
- B. General: The entire finish of interior architectural woodwork is specified in this Section, regardless of whether shop applied or applied after installation.
 - 1. Shop Finishing: To the greatest extent possible, finish architectural woodwork at the fabrication shop. Defer only final touch up, cleaning, and polishing until after installation.
- C. General: The priming and shop finishing (if any) of interior architectural woodwork required to be performed at the fabrication shop are specified in this Section. Refer to Division 9 Section "Painting" for final finishing of installed architectural woodwork and for material and application requirements of prime coats for woodwork not specified to receive final finish in this Section.
- D. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - Backpriming: Apply one coat of sealer or primer compatible with finish coats to concealed surfaces of woodwork, including backs of trim, cabinets, paneling, and ornamental work and the underside of countertops. Apply 2 coats to back of paneling. Concealed surfaces of plastic laminate-clad woodwork do not require backpriming when surfaced with plastic laminate or thermoset decorative overlay.
- E. Washcoat for Stained Finish: Apply a vinyl washcoat to woodwork made from closed-grain wood before staining and finishing.

- F. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
- G. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
 - 1. Apply vinyl washcoat sealer after staining and before filling.
- H. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and satin gloss sheen. Grade: Premium.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

3.2 INSTALLATION

- A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.
- B. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm)
- C. for plumb and level (including tops).
- D. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with recommendations of chemical treatment manufacturer, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.
- G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Do not use pieces less than 36 inches (900 mm) long, except where necessary. Stagger joints in adjacent and related members. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
 - 1. Install standing and running trim with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) variation from a straight line.
- H. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
- I. Tops: Anchor securely to base units and other support systems as indicated. Calk space between backsplash and wall with specified sealant.

- 1. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
- 2. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c.
- J. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips and by blind nailing on backup strips, splined-connection strips, and similar associated trim and framing. Do not face nail unless otherwise indicated.
 - 1. Install flush paneling with no more than 1/16 inch in 96-inch (1.5 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.
- K. Complete the finishing work specified in this Section to the extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in the shop.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork where possible to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

3.4 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to fabricator and Installer that ensures that woodwork is without damage or deterioration at the time of Substantial Completion.
- 3.5 CABINET HARDWARE AND ACCESSORY SCHEDULE (For cabinets and countertops)
 - A. BHMA numbers are used below to designate hardware requirements, except as otherwise indicated.
 - B. Concealed (European Type) Hinges: B01602.
 - C. Pulls: Wire pulls, 5 inches (127 mm) long, 2-1/2 inches (62 mm) deep, and 5/16 inches (8 mm) in diameter satin chrome finish.
 - D. Adjustable Shelf Standards: B04071.
 - 1. Shelf Rests for Standards: B04081.
 - E. Shelf Rests: B04013.
 - F. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, complying with BHMA A156.9, Grade 1 and rated for the following loads:
 - 1. Box Drawer Slides: 75 lbf (330 N).
 - 2. File Drawer Slides: 150 lbf (670 N).
 - 3. Pencil Drawer Slides: 45 lbf (200 N).
 - G. Door Locks: E07121.
 - H. Drawer Locks: E07041.
 - I. Grommets for cable passage through countertops: 2 inch (25 mm) OD black, molded-plastic grommets with 1 3/4-inch (19-mm) hole and black plastic cap with slot for wire passage.

END OF SECTION 064020

SECTION 066510 - SOLID SURFACE FABRICATIONS

PART 1 — GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following horizontal and trim solid surface product types:
 - 1. Countertops with sinks
 - 2. Laboratory countertops
 - 3. Lavatory tops with undermount bowls
 - 4. Lavatory tops with integral bowls
 - 5. Reception areas
 - 6. Vanity tops
 - 7. Tabletops
 - 8. Bar tops
 - 9. Seats
 - 10. Cold cafeteria surfaces
 - 11. Hot cafeteria surfaces
 - 14. Cove backsplashes

1.3 DEFINITION

A. Solid surface is defined as nonporous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment.

1.4 SUBMITTALS

A. Product data:

1. For each type of product indicated.

B. Shop drawings:

- 1. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices and other components.
 - a. Show full-size details, edge details, thermoforming requirements, attachments, etc.
 - b. Show locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.
 - c. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste receptacle and other items installed in solid surface.

C. Samples:

- 1. For each type of product indicated.
 - a. Submit minimum 6-inch by 6-inch sample in specified gloss.
 - b. Cut sample and seam together for representation of inconspicuous seam.
 - c. Indicate full range of color and pattern variation.
- 2. Approved samples will be retained as a standard for work.

D. Product data:

 Indicate product description, fabrication information and compliance with specified performance requirements.

E. Product certificates:

1. For each type of product, signed by product manufacturer.

F. Maintenance data:

- Submit manufacturer's care and maintenance data, including repair and cleaning instructions.
 - a. Maintenance kit for finishes shall be submitted.
- 2. Include in project closeout documents.

1.5 QUALITY ASSURANCE

A. Qualifications:

 Shop that employs skilled workers who custom fabricate products similar to those required for this project and whose products have a record of successful in-service performance.

B. Fabricator/installer qualifications:

 Work of this section shall be by a certified fabricator/installer, certified in writing by the manufacturer.

C. Applicable standards:

- 1. Standards of the following, as referenced herein:
 - a. American National Standards Institute (ANSI)
 - b. American Society for Testing and Materials (ASTM)
 - c. National Electrical Manufacturers Association (NEMA)
 - d. NSF International
- 2. Fire test response characteristics:
 - a. Provide with the following Class A (Class I) surface burning characteristics as determined by testing identical products per UL 723 (ASTM E84) or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1) Flame Spread Index: 25 or less.
 - 2) Smoke Developed Index: 450 or less.

D. Coordination drawings:

- 1. Shall be prepared indicating:
 - a. Plumbing work.
 - b. Electrical work.
 - c. Miscellaneous steel for the general work.
 - d. Indicate location of all walls (rated and non-rated), blocking locations and recessed wall items, etc.

2. Content:

- a. Project-specific information, drawn accurately to scale.
- b. Do not base coordination drawings on reproductions of the contract documents or standard printed data.
- c. Indicate dimensions shown on the contract drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements.
- d. Provide alternate sketches to designer for resolution of such conflicts.
 - 1) Minor dimension changes and difficult installations will not be considered changes to the contract.

E. Drawings shall:

- 1. Be produced in 1/2-inch scale for all fabricated items.
- F. Drawings must be complete and submitted to the architect within 60 days after award of contract for record only.

- 1. No review or approval will be forthcoming.
- G. Pre-installation conference:
 - 1. Conduct conference at project site to comply with requirements in Division 1.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver no components to project site until areas are ready for installation.
- B. Store components indoors prior to installation.
- C. Handle materials to prevent damage to finished surfaces.
 - 1. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 WARRANTY

- A. Provide manufacturer's warranty against defects in materials.
 - 1. Warranty shall provide material and labor to repair or replace defective materials.
 - 2. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted.
- B. Manufacturer's warranty period:
 - 1. Ten years from date of substantial completion.

1.8 MAINTENANCE

A. Provide maintenance requirements as specified by the manufacturer.

PART 2 — PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Subject to compliance with requirements, provide products by one of the following:
 - a. Corian® surfaces from the DuPont company (basis of design).
 - b. Architect Approved Equal

2.2 MATERIALS

- A. Solid polymer components
 - 1. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.
 - 2. Superficial damage to a depth of 0.010 inch (.25 mm) shall be repairable by sanding and/or polishing.
- B. Thickness:
 - 1. 1/2 inch
- D. Inlays:
 - 1. Fabricate using manufacturer's approved method.
 - 2. Rout 1/8" deep max. groove for inlay to pattern indicated on designer's drawings.
 - 3. Fill groove using methods approved by manufacturer, avoiding air bubbles or voids.
 - 4. Overfill inlay area.
 - 5. Allow area to fully cure.
 - a. Do not overheat inlay while sanding.
 - 6. Finish and touch up to uniform appearance.
- E. Integral sink:
 - 3. Mounting:
 - a. Seamed undermount.

3. Mounting: a. Seamed undermount.

G. Backsplash:

1. Applied.

H. Sidesplash:

1. Applied.

I. Performance characteristics:

Property Tensile Strength Tensile Modulus Tensile Elongation Flexural Strength Flexural Modulus Hardness	Typical Result 6,000 psi 1.5 x 10 ⁻⁶ psi 0.4% min. 10,000 psi 1.2 x 10 ⁻⁶ psi >85	Test ASTM D 638 ASTM D 638 ASTM D 638 ASTM D 790 ASTM D 790 Rockwell "M" Scale ASTM D 785 Barcol Impressor
	30	ASTM D 2583
Thermal Expansion	3.02 x 10 ⁻⁵ in./in./°C (1.80 x 10 ⁻⁵ in./in./°F)	ASTM D 696
Gloss (60° Gardner)	5–75 (matte—highly polished)	ANSI Z124
Light Resistance	(Xenon Arc) No effect	NEMA LD 3-2000
Wear and Cleanability	Passes	Method 3.3 ANSI Z124.3 &
·		Z124.6
Stain Resistance: Sheets	Passes	ANSI Z124.3 & Z124.6
Fungus and Bacteria Resistance Boiling Water Resistance	Does not support microbial growth No visible change	ASTM G21&G22 NEMA LD 3-2000
High Town continue Desigtance	No obourse	Method 3.5
High Temperature Resistance	No change	NEMA LD 3-2000 Method 3.6
Izod Impact	0.28 ftlbs./in. of notch	ASTM D 256
(Notched Specimen)		(Method A)
Ball Impact Resistance: Sheets	No fracture—1/2 lb. ball:	NEMA LD 3-2000 Method 3.8
Resistance. Sineets	1/4" slab—36" drop 1/2" slab—144" drop	Method 3.6
Weatherability	$\Delta E^*_{94} < 5$ in 1,000 hrs.	ASTM G 155
Specific Gravity †	1.7	
Water Absorption	Long-term	ASTM D 570
	0.4% (3/4")	
	0.6% (1⁄2") 0.8% (1⁄4")	
Toxicity	99 (solid colors)	Pittsburgh Protocol
•	66 (patterned colors)	Test ("LC50"Test)
Flammability	All colors	ASTM E 84,
	(Class I and Class A)	NFPA 255 & UL 723
Flame Spread Index	<25	OL 120
Smoke Developed Index	<25	

† Approximate weight per square foot: 1/4" (6 mm) 2.2 lbs., 1/2" (12.3 mm) 4.4 lbs. Shapes meet or exceed the ANSI Z124.3 and ANSI Z124.6 standards for plastic sinks and lavatories. NEMA results based on the NEMA LD 3-2000

2.3 ACCESSORIES

A. Joint adhesive:

1. Manufacturer's standard one- or two-part adhesive kit to create inconspicuous, nonporous joints.

B. Sealant:

- 1. Manufacturer's standard mildew-resistant, FDA-compliant, NSF 51-compliant (food zone any type), UL-listed silicone sealant in colors matching components.
- C. Sink/lavatory mounting hardware:
 - 1. Manufacturer's standard bowl clips, panel inserts and fasteners for attachment of undermount sinks/lavatories.

D. Conductive tape:

1. Manufacturer's standard aluminum foil tape, with required thickness, for use with cutouts near heat sources.

E. Insulating felt tape:

1. Manufacturer's standard for use with conductive tape in insulating solid surface material from adjacent heat source.

2.4 FACTORY FABRICATION

A. Shop assembly

- Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's printed instructions and technical bulletins.
- 2. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints.
 - a. Reinforce with strip of solid polymer material, 2" wide.
- 3. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings.
- 4. Rout and finish component edges with clean, sharp returns.
 - a. Rout cutouts, radii and contours to template.
 - b. Smooth edges.
 - c. Repair or reject defective and inaccurate work.

2.5 FINISHES

A. Select from the manufacturer's standard color chart.

PART 3 — EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
 - 1. Provide product in the largest pieces available.
 - 2. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.
 - a. Exposed joints/seams shall not be allowed.

- 3. Reinforce field joints with solid surface strips extending a minimum of 1 inch on either side of the seam with the strip being the same thickness as the top.
- 4. Cut and finish component edges with clean, sharp returns.
- 5. Rout radii and contours to template.
- 6. Anchor securely to base cabinets or other supports.
- 7. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop.
- 8. Carefully dress joints smooth, remove surface scratches and clean entire surface.
- 9. Install countertops with no more than 1/8-inch (3 mm) sag, bow or other variation from a straight line.
- B. Coved backsplashes and applied sidesplashes:
 - Install applied sidesplashes using manufacturer's standard color-matched silicone sealant.
 - Adhere applied sidesplashes to countertops using manufacturer's standard colormatched silicone sealant.
- C. Coved backsplashes and sidesplashes:
 - 1. Provide coved backsplashes and sidesplashes at all walls and adjacent millwork.
 - 2. Fabricate radius cove at intersection of counters with backsplashes to dimensions shown on the drawings.
 - 3. Adhere to countertops using manufacturer's standard color-matched Joint Adhesive.
- D. Color inlays:
 - 1. Comply with product data from manufacturer.
 - 2. Rout groove for inlay to straight edge or pattern indicated on drawings.
 - 3. Fill groove using material furnished by manufacturer.
 - 4. Cure inlay, finish and touch up to uniform appearance.
- E. Integral sinks/vanities:
 - 1. Provide solid surface materials bowls and/or lavatories sinks with overflows in locations shown on the drawings.
 - 2. Secure sinks and lavatory bowls to tops using manufacturer's recommended sealant, adhesive and mounting hardware to maintain warranty.

3.3 REPAIR

A. Repair or replace damaged work which cannot be repaired to architect's satisfaction.

3.4 CLEANING AND PROTECTION

- A. Keep components clean during installation.
- B. Remove adhesives, sealants and other stains.

END OF SECTION 066510

SECTION 071900

WATER REPELLENTS AND SEALANTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide silicone emulsion coating for damp-proofing of above-grade masonry surfaces

1.2 RELATED DOCUMENTS

Conditions of the Contract.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's technical product data for each type of sealing product specified. Include data substantiating that the materials comply with specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site with seals and labels intact, in manufacturer's original containers, free of any type of defect or damaged.
- B. It is the responsibility of the contractor to secure all material and equipment on the job site.
- C. Materials cannot be stored where temperatures may drop to or below freezing (32° Fahrenheit).

1.5 JOB CONDITIONS

- A. Do not apply Seal-a-Pore in inclement weather, if rain is expected within 12 hours, or if temperature is below 40°F or will fall below 40°F within 12 hours.
- B. If applying Seal-a-Pore by spray, protect nearby areas from overspray. It is the contractor's responsibility to protect other areas of the building or nearby personal property from solvents, cleaners, or waterproofing products utilized during installation.

PART 2 - PRODUCTS

1.1 PRODUCTS - GENERAL

A. Basis of Design: Materials, manufacturer's product designations, and/or manufacturer's names specified herein shall be regarded as the minimum standard of quality required for work of this Section. Comply with all manufacturer and contractor/fabricator quality and performance criteria specified in Part 1.

1.2 ACCEPTABLE MANUFACTURERS

A. The design is based upon waterproofing systems engineered and manufactured by The Garland Company or approved equal. It is the intent of the ADF-C to have the same manufactured coating applied as the previous Scope of Work on the building:

1.3 MATERIALS

- A. Provide damp-proofing coating and related products as follows:
 - Seal-a-Pore: A silicone emulsion to damp-proof above grade masonry surfaces, containing a silane/siloxane silicone blend that provides water repellency by chemically reacting with the substrate.
 - a. Color Milky White
 - b. Carrier Water
 - c. Density @ 77°F 8.3 lb.gal. (ASTM D 1475)
 - d. Viscosity @ 77°F Typical 15 sec. (ASTM D4212)
 - e. Volatile Organic Content 110g/l
 - Tuff-Stuff: A moisture-curing, single-component, non-sag polyurethane sealant designed to maintain an effective bond and seal between materials of similar and dissimilar surfaces, porosities, and coefficients of expansion. Used to fill small holes and cracks in masonry prior to application of dampproofing material.
 - Color Aluminum Stone, Classic Bronze, Natural Stone, or True White (To be selected by architect for best match to existing masonry surfaces)
 - b. 100% Modulus- 50 psi (ASTM C719)
 - c. Adhesion-in-Peel 25 pli (ASTM C920)
 - d. Bond Passes Durability Class 25 (ASTM C920)
 - e. Hardness, Shore A 27 (ASTM C920, 15-50)
 - f. Tack Free Time 1.5-2 hours (ASTM C679)
 - g. Tensile Strength 150 psi (ASTM D412)
 - h. Ultimate Elongation 700% (ASTM D412)
 - 3. Nontoxic Biodegradable Cleaner: B-Clean is a heavy-duty chemical formulation designed to clean a variety of masonry substrates including: concrete, brick, stone, aggregate, and block surfaces.

NOTE: Allow additional material for rough or irregular surfaces and up to 10% for material loss during application and differences in substrate porosity.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Cleaning Methods: All masonry surfaces to be coated must be free of dirt, salt deposits, and other foreign materials.
 - 1. Nontoxic Biodegradable Cleaner: Nontoxic Biodegradable Concrete & Masonry Cleaner: Scrape, sand, or wire brush all hard or glossy surfaces and residual contaminants to assure effective cleaning. Use the most abrasive methods necessary to remove all contaminants that will inhibit the cleaning solution from properly saturating the substrate.

 Rinse the substrate to be treated thoroughly with clean water to remove

excess debris and dampen the surface. Beginning at the top of the substrate working down to the bottom, generously apply the B-Clean solution directly to the affected areas using overlapping patterns. Allow the solution to soak into surface for 20-30 minutes. Do NOT allow surface to dry. Reapply a light mist of the solution intermittently to ensure the surface remains damp. Depending on the degree of contamination and exposure a stiff bristle brush may be

- required once the solution reacts. Next, using overlapping patterns rinse the surface from top to bottom with water. Additional applications may be required dependent upon the severity of the contaminant, using the same approach as above. Allow the substrate sufficient time to dry.
- 2. Solvent & Acid Cleaners: Wipe up grease or oil with a solvent and absorbent material. Disposal of this material should be in accordance with local laws and codes. Wash with solvent-alkaline cleaners diluted one part cleaner and five parts water. Rinse thoroughly with clean water. If evidence of oil film remains as indicated by water "beading," etch surface with 10% solution muriatic acid. Agitate surface with stiff bristle broom; then rinse with clean water. Remove curing compounds by etching with 10% muriatic acid followed by clean water rinse. Allow to thoroughly dry before applying coating. Grinding or sandblasting can remove heavy deposits of contaminants. Any residual traces of asphalt stains must be sealed with an epoxy primer to avoid staining of light colored top coats. Apply primer in two coats and allow a minimum of 48 hours cure time.
- B. Repoint any loose or missing joints in the masonry wall.
 - 1. Defective mortar or stucco areas should be repaired using a cement-based patching compound.
- C. New masonry walls require 3 week cure time prior to application of Seal-a-Pore.

D. Joint Treatment:

- Non-moving Cracks: Stripe coats all non-moving cracks. Fill the crack first with a
 bead of Tuff-Stuff MS sealant and strike flush. After filling, apply Tuff-Coat for a
 distance of 2" on each side of the crack 16-20 mils thick and allow curing. When
 applying the elastomeric coating system on the wall, go over the stripe coat to
 achieve a total thickness of 48-52 mils.
- 2. Moving Cracks: Remove all dirt and loose chips of concrete from the crack. Fill with Tuff-Stuff MS and strike flush with the wall surface. Center 4" wide piece of polyester tape over the crack and adhere it firmly and thoroughly to the wall. Stripe coat 16-20 mils of Tuff-Coat over the polyester tape and for 2" on each side of the crack. When applying the elastomeric coating system on the wall, go over the stripe coat to achieve a total thickness of 48-52 mils.
- Control Joints: Place a backer material (solvent expanded plastic such as
 polyethylene or polypropylene) in joint. The backer material should be oversized
 so it can be compressed into the joint and flush to the wall surface. Apply a bead
 of Tuff-Stuff MS sealant over the backer rod sealing the joint and strike flush with
 the wall surface.
- E. Repair cracks and holes in the masonry with Tuff-Stuff urethane sealant.
 - 1. Seal around any penetrations, fasteners, or equipment attached to wall.
 - Once Tuff-Stuff is applied, allow 24 hour cure time prior to application of Seal-a-Pore VOC.

3.2 DAMP-PROOFING APPLICATION

- A. Once the surface is prepared, apply Seal-a-Pore with a wide brush or spray until surface appears shiny and wet.
- Coverage rates will vary from 75 to 200 sq. ft. per gallon, depending on porosity of substrate.

3.3 FIELD QUALITY CONTROL

- A. The contractor for work under this section shall maintain a quality control program specifically to verify compliance with this specification. A daily log shall be kept to record actions in the field.
- B. Inspections: A minimum of three (Substrate, Application and Final) inspections by an approved manufacturer's representative will be required on all projects requiring a warranty.

SECTION 072200 - AIR BARRIER/WEATHER RESISTANT BARRIER

PART 1 GENERAL

1.00 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.01 Summary:

- A. Includes but not limited to:
 - Furnish and install air barrier/weather resistant barrier over exterior of wall sheathing at all locations regardless of whether or not indicated on drawings to protect exterior sheathing and interior walls.

1.02 Related Sections

- A. Section 05400 Cold Formed Metal Framing
- B. Section 06160 Sheathing
- C. Section 07610 Flashing and Sheet Metal

1.03 References:

- A. American Society for Testing and Materials
- B. Technical Association of the Pulp and Paper Industry
- C. American Association of Textile Chemists and Colorists

1.04 Submittals:

- A. General: Submit each item in this Article according to the conditions of the Contract and Division I Specifications Sections.
- B. Product Data: Submit product specifications, technical data and installation instructions of manufacturer equaling or exceeding those specified.

1.05 Quality Assurance

- A. Qualifications:
 - Installer with successful experience in the installation of air barrier/secondary weather resistant barriers.
- B. Install job mock-up using specified air barrier/secondary weather resistant barrier with system of fastening and taping seams as per manufacturer's instructions. Obtain architect's approval of system for appearance and workmanship standard.

PART 2 - PRODUCTS

2.01 Manufacturers

A. Acceptable Manufacturers:

1. DuPont Weatherization SystemsContact:

4417 Lancaster Pike 800-448-9835

Building 728

Wilmington, DE 19805 www.tyvek.com

2. Approved equal.

2.02 Materials

A. DuPont™ Tyvek® CommercialWrap®: A flash spunbonded olefin, non-woven, non-perforated secondary weather resistant barrier.

B. Performance Characteristics

- 1. AATCC-127, Water Penetration Resistance, exceeded at 280
- 2. TAPPI T–460, Gurley Hill (sec/100cc) Air infiltration at >1500 seconds
- 3. ASTM E 96 Method B(g/m2–24hr.)Water vapor transmission of 200
- 4. TAPPI T-41D, Basis weight of 2.7oz/yd
- 5. ASTM E96 Method B, Water Vapor Transmission, 28 perms
- 6. ASTM E1677, Air Retarder Material Standard Specification, Type I air barrier

C. Sealing Tape/Fasteners

- 1. DuPont™ Tyvek® Tape, DuPont Weatherization Systems, or approved equal.
- 2. <u>For steel frame construction</u>: DuPont™ Tyvek® Wrap Cap Screws, DuPont Weatherization Systems, or approved equal. 1 5/8" rust resistant screws with 2" diameter plastic cap,
- 3. <u>For wood frame construction</u>: DuPont[™] Tyvek® Wrap Caps, DuPont Weatherization Systems, or approved equal. Nails with large heads or plastic washers.
- 4, Caulks or Sealants: polyurethane or elastomeric sealants
 - 1. Available Products:
 - a. OSI® Quad Pro-Series®, solvent release butyl rubber sealant
 - b. DAP® Dynaflex 230™
 - c. Other products as approved and recommended by air barrier/weather resistant barrier manufacturer.

PART 3 - EXECUTION

3.01 Installation

- A. Install Air Barrier over exterior side of exterior wall sheathing.
 - 1. Install Air Barrier after sheathing is installed and before windows and doors are installed. Install lower level barrier prior to upper layers to ensure proper shingling of layers.
 - 2. Overlap Air Barrier at corners of building by a minimum of 12 inches.
 - 3. Overlap Air Barrier vertical seams by a minimum of 6 inches.
 - Ensure barrier is plum and level with foundation, and unroll extending Air Barrier over window and door openings.
 - 5. Attach Air Barrier to wood, insulated sheathing board or exterior gypsum with plastic cap nails every 12" to 18" on vertical stud line with wood stud framing, and screws with washers to metal stud framing. When attaching to masonry, use adhesive recommended by manufacturer.
 - 6. Prepare window and door rough openings as follows:
 - a. Prepare each window rough opening by cutting a modified "I" pattern in the Air Barrier.
 - 1. Horizontally cut Air Barrier along bottom of header.
 - 2. Vertically cut Air Barrier down the center of window openings from the top of the window opening down to 2/3 of the way to the bottom of the window openings.
 - 3. Diagonally cut Air Barrier from the bottom of the vertical cut to the left and right corners of opening.
 - 4. Fold side and bottom flaps into window opening and fasten every 6 inches. Trim off excess.
 - b. Prepare each rough door opening by cutting a standard "I" pattern in the Air Barrier.
 - 1. Horizontally cut Air Barrier along bottom of door frame header and along top of sill.
 - 2. Vertically cut Air Barrier down the center of door openings from the top of the door opening (header) down to the bottom of the door opening (sill).
 - 3. Fold side flaps inside around door openings and fasten every 6 inches. Trim off excess.
 - 7. Tape all horizontal and vertical seam of Air Barrier with DuPont™ Tyvek® Tape.
 - 8. Seal all tears and cuts in Air Barrier with DuPont™ Tyvek® Tape.

End of Section

SECTION 072701-FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes firestopping for the following:

- Penetrations through fire-resistance-rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
- 2. Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
- 3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.
- 4. Sealant joints in fire-resistance-rated construction.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.
- B.F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F-Ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.
- C.T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T-Ratings, in addition to F-Ratings, as determined per ASTM E 814, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assemblies are required where the following conditions exist:
 - 1. Where firestop systems protect penetrations located outside of wall cavities.
 - 2. Where firestop systems protect penetrations located outside fire-resistive shaft enclosures.
 - 3. Where firestop systems protect penetrations located in construction containing doors required to have a temperature-rise rating.
 - 4. Where firestop systems protect penetrating items larger than a four inch (4") (100 mm) diameter nominal pipe or 16 sq. in. (100 sq. cm) in overall cross-sectional area.
- D.Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per ASTM E 119, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.
- E.For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems. For floor penetrations with annular spaces exceeding four inches (4") (100 mm) or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.
 - 2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

F.For firestopping exposed to view, provide products with flame-spread values of less than 25 and

smoke-developed values of less than 450, as determined per ASTM E 84.

1.4 SUBMITTALS

- A. General: Submit the following according to General Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
 - 1. Certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.
- C. Shop drawings detailing materials, installation methods, and relationships to adjoining construction for each through-penetration firestop system, and each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.
 - Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop configuration for construction and penetrating items.
- D. Product certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.
- E. Product test reports from, and based on tests performed by, a qualified testing and inspecting agency evidencing compliance of firestopping with requirements based on comprehensive testing of current products.
- F. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of architects, engineers and owners, and other information specified.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the "System Performance Requirements" article:
 - Firestopping tests are performed by a qualified testing and inspecting agency. A
 qualified testing and inspecting agency is UL, Warnock Hersey, or another agency
 performing testing and follow-up inspection services for firestop systems that is acceptable
 to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per ASTM E 814 under conditions where positive furnace pressure differential of at least 0.01 inch of water (2.5 Pa) is maintained at a distance of 0.78 inch (20 mm) below the fill materials surrounding the penetrating items in the test assembly. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in their "Fire Resistance Directory," by Warnock Hersey, oranother qualified testing and inspecting agency.
 - 3. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E 119 under conditions where the positive furnace pressure differential is at least 0.01 inch of water (2.5 Pa), as measured 0.78 inch (20 mm) from the face exposed to furnace fire. Provide systems complying with the following requirements:
 - a. Fire-Resistance Ratings of Joint Sealants: As indicated by reference to design designations listed by UL in their "Fire Resistance Directory" or by another qualified testing and inspecting agency.
 - b. Joint sealants, including backing materials, bear classification marking of qualified testing and inspection agency.

- B.Information on drawings referring to specific design designations of through-penetration firestop systems is intended to establish requirements for performance based on conditions that are expected to exist during installation. Any changes in conditions and designated systems require the Architect's prior approval. Submit documentation showing that the performance of proposed substitutions equals or exceeds that of the systems they would replace and are acceptable to authorities having jurisdiction.
- C. Installer Qualifications: Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff, and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- D.Single-Source Responsibility: Obtain through-penetration firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.
- E. Field-Constructed Mockup: Prior to installing firestopping, erect mockups for each different through-

penetration firestop system indicated to verify selections made and to demonstrate qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final installations.

- 1. Locate mockups on site as directed by the Architect.
- Notify Architect two (2) weeks in advance of the dates and times when mockups will be erected.
- 3. Obtain Architect's acceptance of mockups before start of final unit of Work.
- 4. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging completed unit of Work.
 - a Accepted mockups in an undisturbed condition at time of Substantial Completion may become part of completed unit of Work.
- F. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."
- G.Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed per specified requirements.
- H.Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
- I Owner will employ and pay a qualified inspection agency to check installed firestopping systems for compliance with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
- B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilation: Ventilate firestopping per firestopping manufacturers' instructions by natural means or,

where this is inadequate, forced air circulation.

1.8 SEQUENCING AND SCHEDULING

- A. Notify Owner's inspection agency at least one (1) week in advance of firestopping installations; confirm dates and times on days preceding each series of installations.
- B. Do not cover up those firestopping installations that will become concealed behind other construction until Owner's inspection agency and authorities having jurisdiction, if required, have examined each installation.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
- B.Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with "System Performance Requirements" article in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:
 - 1. Permanent forming/damming/backing materials including the following:
 - a. Semirefractory fiber (mineral wool) insulation.
 - b. Ceramic fiber.
 - c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - d. Fire-rated formboard.
 - e. Joint fillers for joint sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - Steel sleeves.
- C.Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

2.2 FILL MATERIALS FOR THROUGH-PENETRATION FIRESTOP SYSTEMS

- A. Ceramic-Fiber and Mastic Coating: Ceramic fibers in bulk form formulated for use with mastic coating, and ceramic fiber manufacturer's mastic coating.
 - Grade for Horizontal Surfaces: Pourable (self-leveling) grade for openings in floors and other horizontal surfaces.
 - 2. Grade for Vertical Surfaces: Nonsag grade for openings in vertical and other surfaces.
- B Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogenous mortar.
- C.Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Mortar:
 - a. K-2 Firestop Mortar, Bio Fireshield, Inc.
 - b. Novasit K-10 Firestop Mortar, Bio Fireshield, Inc.
 - c. KBS-Mortar Seal, International Protective Coatings Corp.
 - d. Or approved equal.

2.3 FIRE-RESISTIVE ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric

sealants of base polymer indicated that complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses, and requirements specified in this Section applicable to fire-resistive joint sealants.

- B. Sealant Colors: Provide color of exposed joint sealants to comply with the following:1. products of type indicated.
- Multicomponent, Nonsag, Urethane Sealant: Type M; Grade NS; Class 25; exposure-related Use
 - NT, and joint-substrate-related Uses M, A, and (as applicable to joint substrates indicated) O.
 - Additional Movement Capability: Provide sealant with the capability to withstand the following percentage change in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, and remain in compliance with other requirements of ASTM C 920 for uses indicated:
 - a. 50 percent movement in both extension and compression for a total of 100 percent movement.
- D. Available Products: Subject to compliance with requirements, products that may be incorporated in

the Work include, but are not limited to, the following:

- Multicomponent, Nonsag, Urethane Sealant:
 - a. Vulkem 922, Mameco International Inc.
 - b. Dynflex, Pecora Corp.
 - c. Dynatred, Pecora Corp.
 - d. Dynatrol II, Pecora Corp.
 - e. Sikaflex 2cn NS, Sika Corp.
 - f. Sonolastic NP 2, Sonneborn Building Products Div., ChemRex Inc.
 - g. Dymeric, Tremco Inc.
 - h. Or approved equal.

2.4 MIXING

A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A.Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
 - 1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
 - 2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form release agents from concrete.
- B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.3 INSTALLING THROUGH-PENETRATION FIRESTOPS

- A. General: Comply with the "System Performance Requirements" article in Part 1 and the throughpenetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
 - Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 INSTALLING FIRE-RESISTIVE JOINT SEALANTS

- A. General: Comply with the "System Performance Requirements" article in Part 1, with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.
- C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.
- D. Tool nonsag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.5 FIELD QUALITY CONTROL

- A. Inspecting agency employed and paid by Owner will examine completed firestopping to determine, in general, if it is being installed in compliance with requirements.
- B. Inspecting agency will report observations promptly and in writing to Contractor and Architect.
- C. Do not proceed to enclose firestopping with other construction until reports of examinations

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are issued.

D. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

3.6 CLEANING

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.
- B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

END OF SECTION

SECTION 079000 - BACKERSEAL

PART 1 – GENERAL

1.01 Work Included

- A. The work shall consist of furnishing and installing waterproof expansion joints in accordance with the details shown on the plans and the requirements of the specifications. Preformed sealant shall be preformed, pre-compressed, self-expanding, sealant system.
- B. Related Work
 - Division 4 Masonry
 - Division 7 Thermal & Moisture Protection
 - Division 7 Sealants, Caulking and Waterproofing

1.02 Submittals

- A. General Submit the following according to Division 1 Specification Section.
- B. Standard Submittal Package Submit typical expansion joint drawing(s) indicating pertinent dimensions, general construction, expansion joint opening dimensions and product information.
- C. Sample of material is required at time of submittal.
- D. All products must be certified by independent test report to exceed the requirements of curtain wall performance tests ASTM E330, E283-04, and E331.
- E. All products must be certified by independent laboratory test report to ASTM E90-09 and to meet or exceed an STC 53 in STC 68 wall and OITC 49 rating in an OITC 52 wall.
- F. All products must be certified by independent laboratory test report to be free in composition of any waxes or wax compounds using FTIR and DSC testing.
- G. All products shall be certified in writing to be: a) capable of withstanding 150°F (65°C) for 3 hours while compressed down to the minimum of movement capability dimension of the basis of design product (-25% of nominal material size) without evidence of any bleeding of impregnation medium from the material; and b) that the same material after the heat stability test and after first being cooled to room temperature will subsequently self-expand to the maximum of movement capability dimension of the basis-of-design product (+25% of nominal material size) within 24 hours at room temperature 68°F (20°C).

1.03 Product Delivery, Storage and Handling

A. Deliver products to site in Manufacturer's original, intact, labeled containers. Handle and protect as necessary to prevent damage or deterioration during shipment, handling and storage. Store in accordance with manufacturer's installation instructions.

1.04 Basis of Design

A. All products shall be designed to meet the specified performance criteria of the project as manufactured by: USA EMSEAL JOINT SYSTEMS, LTD 25 Bridle Lane, Westborough, MA 01581-2603, Toll Free: 800-526-8365, EMSEAL, LLC 120 Carrier Drive, Toronto, Ontario, Canada M9W 5R1 Toll Free: 800-526-8365, www.emseal.com

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B. Alternate manufacturers must demonstrate that their products meet or exceed the design criteria and must submit certified performance test reports performed by nationally recognized independent laboratories as called for in section 1.02 Submittals. Submittal of alternates must be made three weeks prior to bid opening to allow proper evaluation time.

1.05 Quality Assurance

A. Warranty – Manufacturer's standard warranty shall apply.

PART 2 - PRODUCT

2.01 General

- A. Provide watertight, energy-efficient exterior and interior joints in vertical-plane walls (above-grade). Typical locations include but are not limited to the following: applications in window perimeters, other façade penetrations such as doors, store fronts, vents, HVAC units, panel to panel joints, curtain walls, control joints, between dissimilar materials, and new-to-existing connections.
- B. Provide BACKERSEAL as manufactured by EMSEAL JOINT SYSTEMS LTD OR APPROVED EQUAL and as indicated on drawings for vertical expansion joint locations.
- C. Preformed sealant shall be preformed, pre-compressed, self-expanding, sealant system. Expanding foam to be cellular foam impregnated with a water-based, non-drying, polymer-modified 100% acrylic dispersion.
- D. Material shall be capable of movements of +25%, -25% (50% total) of nominal material size.
- E. BACKERSEAL to be installed recessed from the substrate faces and to receive a field-applied coating of low-modulus liquid sealant (by others) not to exceed ¼ inch, (6mm) thick.
- F. BACKERSEAL to be installed at depth sufficient to allow installation of properly sized backer rod and liquid sealant (by others) in front of material.
- G. Select the sealant system model appropriate to the movement and design requirements at each joint location that meet the project specification or as defined by the structural engineer of record.
- H. Manufacturer's Checklist must be filled out by expansion joint subcontractor and returned to manufacturer at time of ordering material.

2.02 Fabrication

A. BACKERSEAL must be supplied precompressed to less than the joint size, packaged in reels or shrink-wrapped lengths (sticks) with a mounting adhesive on one face.

PART 3 - EXECUTION

3.01 Installation

BACKERSEAL 079000 - 2

A. Preparation of the Work Area

- The contractor shall provide a properly formed and prepared expansion joint openings constructed to the exact dimensions and elevations shown on shown on the contract drawings. Deviations from these dimensions will not be allowed without the written consent of the engineer of record.
- 2. The contractor shall clean the joint opening of all contaminants immediately prior to installation of expansion joint system. Repair spalled, irregular or unsound joint surfaces using accepted industry practices for repair of the substrates in question. Remove protruding roughness to ensure joint sides are smooth. Ensure that there is sufficient depth to receive the full depth of the size of the BACKERSEAL being installed. Refer to Manufacturers Installation Guide for detailed step-by-step instructions.
- 3. No drilling, or screwing, or fasteners of any type are permitted to anchor the system into the substrate.

3.02 Clean and Protect

A. Protect the system and its components during construction. Subsequent damage to the expansion joint system will be repaired at the general contractor's expense. After work is complete, clean exposed surfaces with a suitable cleaner that will not harm or attack the finish.

END OF SECTION

BACKERSEAL 079000 - 3

SECTION 079010 - JOINT SEALANTS

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 this Section.

1.2 SUMMARY

- A. This Section includes joint sealants for the following locations:
 - 1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:
 - a. Control joints in cast-in-place concrete.
 - b. Control joints in unit masonry.
 - c. Joints between different materials listed above.
 - d. Perimeter joints between materials listed above and frames of doors and windows.
 - e. Control joints in ceiling and overhead surfaces.
 - f. Other joints as indicated.
 - 2. Exterior joints in horizontal traffic surfaces as indicated below:
 - a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
 - b. Other joints as indicated.
 - 3. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Joints between tops of non-load-bearing unit masonry walls and underside of cast-inplace concrete slabs and beams.
 - d. Tile control and expansion joints.
 - e. Vertical control joints on exposed surfaces of interior unit masonry walls and partitions.
 - f. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
 - g. Perimeter joints of toilet fixtures.
 - h. Other joints as indicated.
 - 4. Interior joints in horizontal traffic surfaces as indicated below:
 - a. Control joints in cast-in-place concrete slabs.
 - b. Other joints as indicated.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 8 Section "Glazing" for sealants used in glazing.
 - 2. Division 8 Section "Aluminium Entrances & Store fronts"
 - 3. Division 8 Section "Metal Window Panels"
 - 4. Division 8 Section "Interior Transaction Window"
 - 5. Division 9 Section "Paints & Coatings".

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.
- B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data from manufacturers for each joint sealant product required.
 - Certification by joint sealant manufacturer that sealants plus the primers and cleaners required for sealant installation comply with local regulations controlling use of volatile organic compounds.
- C. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.
- D. Samples for verification purposes of each type and color of joint sealant required. Install joint sealant samples in 1/2-inch (13-mm) wide joints formed between two (2) 6-inch (6") (150-mm) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- E. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.
- F. Qualification data complying with requirements specified in "Quality Assurance" article. Include list of completed projects with project names addresses, names of architects and owners, plus other information specified.
- G. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.
- H. Product test reports for each type of joint sealants indicated, evidencing compliance with requirements specified.
- I. Preconstruction field test reports indicating which products and joint preparation methods demonstrate acceptable adhesion to joint substrates.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.
- B. Testing Laboratory Qualifications: To qualify for acceptance, an independent testing laboratory must demonstrate to Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM-E699, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying progress of the Work.
- C. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.
- D. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers samples of materials that will contact or affect joint sealants for compatibility and adhesion testing as indicated below:
 - 1. Use test methods standard with manufacturer to determine if priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - a. Perform tests under normal environmental conditions that will exist during actual installation.
 - 2. Submit not less than nine (9) pieces of each type of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.

- Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the Work.
- 4. Investigate materials failing compatibility or adhesion tests and obtain joint sealant manufacturer's written recommendations for corrective measures, including use of specially formulated primers.
- Testing will not be required when joint sealant manufacturer is able to submit joint preparation
 data required above that are acceptable to Architect and are based on previous testing of
 current sealant products for adhesion to, and compatibility with, joint substrates and other
 materials matching those submitted.
- E. Product Testing: Provide comprehensive test data for each type of joint sealant based on tests conducted by a qualified independent testing laboratory on current product formulations within a 24-month period preceding date of Contractor's submittal of test results to Architect.
 - 1. Test elastomeric sealants for compliance with requirements specified by reference to ASTM C 920. Include test results for hardness; stain resistance, adhesion and cohesion under cyclic movement (per ASTM C 719), low-temperature flexibility, and modulus of elasticity at 100-percent strain, effects of heat aging, and effects of accelerated weathering.
 - 2. Include test results performed on joint sealants after they have cured for one (1) year.
- F. Preconstruction Field Testing: Prior to installation of joint sealants, field-test their adhesion to joint substrates as follows:
 - Locate test joints where indicated or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.
 - b. Each type of non-elastomeric sealant and joint substrate indicated.
 - Notify Architect one (1) week in advance of the dates and times when mock-ups will be erected.
 - 4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
 - 5. Test Method: Test joint sealants by hand pull method described below:
 - Install joint sealants in 60-inches (1500 mm) joint lengths using same materials and methods for joint preparation and joint sealant installation required for completed Work. Allow sealants to cure fully before testing.
 - b. Make knife cuts horizontally from one side of joint to the other followed by two (2) vertical cuts approximately two inches (2") (50 mm) long at side of joint and meeting horizontal cut at top of two inch (2") (50-mm) cuts. Place a mark one inch (1) (25 mm) from top of two inch (2") (50-mm) piece.
 - c. Use fingers to grasp two inch (2") (50-mm) piece of sealant just above one inch (1) (25-mm) mark; pull firmly down at a 90-degree angle or more while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
 - 6. Report whether or not sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
 - 7. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.
- G. Field-Constructed Mock-Ups: Prior to installation of joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution:
 - 1. Joints in field-constructed mock-ups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants specified in this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
 - When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
 - 2. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 degrees F (4 deg C).
 - 3. When joint substrates are wet.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.8 SEQUENCING AND SCHEDULING

A. Sequence installation of joint sealants to occur not less than 21 or more than 30 days after completion of waterproofing, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors: Provide color of exposed joint sealants to comply with the following:
 - 1. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and other requirements indicated on each Elastomeric Joint Sealant Data Sheet at end of this Section, including those requirements referencing ASTM C 920 classifications for Type, Grade, Class, and Uses.
- B. Available Products: Subject to compliance with requirements, elastomeric sealants that may be incorporated in the Work include, but are not limited to, the products specified in each Elastomeric Sealant Data Sheet.

2.3 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, non-staining, non-waxing, non-extruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, non-outgassing in unruptured state.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:
 - Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
 - 3. Remove laitance and form release agents from concrete.
 - 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- D. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
 - 1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - a. Do not leave gaps between ends of joint fillers.
 - b. Do not stretch, twist, puncture, or tear joint fillers.
 - c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.
 - 2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.
- E. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 - 1. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.
 - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

3.6 PRODUCT DATA SHEET 1 - ELASTOMERIC JOINT SEALANT

A. Elastomeric Joint Sealant Designation: ES # 1

- B. Base Polymer: Urethane.
- C. Type: M (multicomponent).
- D. Grade: NS (nonsag). P (pourable).
- E. Class: 25.
- F. Additional Movement Capability: 50-percent movement in extension and 25-percent in compression for a total of 75-percent movement.
- G. Uses Related to Exposure: T (traffic) and NT (nontraffic).
- H. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - 1. Use O Joint Substrates: Glazing, steel and concrete masonry units
- Products
 - 1. W. R. Meadows, Inc. DUALTHANE and POURTHANE
 - 2. Sika Corp.: SIKAFLEX 2cNS and SL
 - 3. Tremco, Inc.: DYMERIC PLUS
 - 4. Or approved equal.

END OF SECTION 079010

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. Standard and custom hollow metal doors and frames.
- 2. Steel sidelight, borrowed lite and transom frames.
- 3. Louvers installed in hollow metal doors.
- 4. Light frames and glazing installed in hollow metal doors.
- B. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI/SDI A250.8 Recommended Specifications for Standard Steel Doors and Frames.
 - 2. ANSI/SDI A250.4 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
 - 3. ANSI/SDI A250.6 Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
 - 4. ANSI/SDI A250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
 - 5. ANSI/SDI A250.11 Recommended Erection Instructions for Steel Frames.
 - 6. ASTM A1008 Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 7. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 8. ASTM A924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 9. ASTM C 1363 Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
 - 10. ANSI/BHMA A156.115 Hardware Preparation in Steel Doors and Frames.
 - 11. ANSI/SDI 122 Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
 - 12. ANSI/NFPA 80 Standard for Fire Doors and Fire Windows; National Fire Protection Association.
 - 13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
 - 14. NFPA 252 Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association
 - 15. UL 10C Positive Pressure Fire Tests of Door Assemblies.
 - 16. UL 1784 Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of anchorages, joints, field splices, and connections.
 - 6. Details of accessories.
 - 7. Details of moldings, removable stops, and glazing.
 - 8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C.
 - 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
 - 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 - 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CECO Door Products.
 - 2. Curries Company.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
- B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Design: Flush panel, 16 gauge.
 - 2. Core Construction: Manufacturer's standard polystyrene. Where indicated, provide doors fabricated as thermal-rated assemblies with a minimum R-value of 2.8 or better.
 - 3. Core Construction: Manufacturer's standard vertical steel-stiffener core. Minimum 22 gauge steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers. Spaces between stiffeners filled with fiberglass insulation (minimum density 0.8#/cubic ft.).
 - 4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 - 5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 - 6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Design: Flush panel, 18 gauge.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.
 - 3. Core Construction: Manufacturer's standard vertical steel-stiffener core. Minimum 22 gauge steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers. Spaces between stiffeners filled with fiberglass insulation (minimum density 0.8#/cubic ft.).
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

- Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
- 5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
- 6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

- 1. CECO Door Products Imperial Series.
- 2. CECO Door Products Steel-Stiffened: Medallion Series.
- 3. Curries Company Steel-Stiffened: 747 Series.

2.4 ENERGY-EFFICIENT HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design specified, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.
- B. Energy Efficient Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.
 - 1. Design: Flush panel.
 - 2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".
 - a. Provide 22 gauge steel stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
 - b. Thermal properties to rate at a fully operable minimum U-Factor 0.29 and R-Value 3.4, including insulated door, thermal-break frame and threshold.
 - Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.36 and R-Value 2.7, including insulated door, kerf type frame, and threshold.
 - 3. Level/Model: Level 2 and Physical Performance Level A (Heavy Duty), Minimum 16 gauge steel, Model 2.
 - 4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
 - 5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 - 6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
 - 7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Manufacturers Basis of Design:

1. CECO Door Products Trio-E/Trio Series.

2. Curries Company 777 Trio-E/Trio Series.

2.5 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames, with the exception of knock down types, with "closed and tight" miter seams continuously welded on face, finished smooth with no visible seam unless otherwise indicated.
 - 3. Frames for Doors (up to 48 inches in width): Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
 - 4. Frames for Doors (48 inches and up in width): Minimum 12 gauge (0.081-inch -2.7-mm) thick steel sheet.
 - 5. Manufacturers Basis of Design:
 - a. CECO Door Products SQ/SU/SR Series.
 - b. Curries Company M/G Series.
- C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames, with the exception of slip-on drywall types, with "closed and tight" miter seams continuously welded on face, finished smooth with no visible seam unless otherwise indicated.
 - 3. Frames for openings up to 48 inches in width: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 - Frames for openings 48 inches and wider in width: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
 - 5. Frames for Borrowed Lights: Minimum 16 gauge (0.053-inch-1.3-mm-) thick steel sheet.
- D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
- E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.6 ENERGY-EFFICIENT HOLLOW METAL FRAMES

A. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames, provide where indicated thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate from minimum 16 gauge galvannealed steel, with positive 3/8" vinyl thermal break and integral vinyl weatherstripping.

2.7 FRAME ANCHORS

A. Jamb Anchors:

- 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
- 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.9 LOUVERS

- A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.
 - 1. Blade Type: Vision proof inverted V or inverted Y.
 - 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.
- B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.
 - 1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
 - 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.10 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.
- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames
- D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

- E. Glazing: Comply with requirements in Division 08 Section "Glazing" and with the hollow metal door manufacturer's written instructions.
 - 1. Factory Glazing: Factory install glazing in doors as indicated. Doors with factory installed glass to include all of the required glazing material.

2.11 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.12 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

- 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
- 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
- Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08
 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fireperformance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on
 which astragal is mounted.
- 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

- 1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
- 2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
- 3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
- 4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.

- 5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
- 6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
- 7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
- 8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
- 9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
- Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.13 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 081113

SECTION 083050 - ACCESS DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of access doors:
 - Wall access doors.
 - 2. Ceiling access doors.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 4 Sections for building in anchors and grouting frames set in masonry construction.
 - 2. Division 9 Section "Gypsum Board Assemblies" for gypsum board walls and ceilings.
 - 3. Division 9 Section "Tile" for ceramic tile walls.
 - 4. Division 15 Section "Duct Accessories" for duct access doors.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of access door assembly specified, including details of construction relative to materials, individual components, profiles, finishes, and fire-protection ratings (if required).
 - 1. Include complete schedule, including types, general locations, sizes, wall and ceiling construction details, latching or locking provisions, and other data pertinent to installation.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain access doors for entire Project from one source and by a single manufacturer.
- B. Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies tested for fire-test-response characteristics per test method as indicated below, and are labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Test Method for Vertical Installations: ASTM E 152.
 - 2. Test Method for Horizontal Installations: ASTM E 119.
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. J.L. Industries.
 - 2. Larsen's Manufacturing Co.
 - 3. Nystrom, Inc.

2.2 MATERIALS

A. Zinc-Coated Steel Sheet: ASTM A 591 (ASTM A 591M), Electrolytic zinc-coated steel sheet with Class C coating and phosphate treatment to prepare surface for painting.

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2.3 ACCESS DOORS

- A. Noninsulated, Fire-Rated Doors for Walls: Self-latching units consisting of frame, trim, door, and hardware, including automatic closer, interior latch release, and complying with the following requirements:
 - 1. Frame: 0.0598-inch- (1.52-mm-) thick zinc-coated steel sheet.
 - 2. Door: 0.0598-inch- (1.52-mm-) thick zinc-coated steel sheet.
 - 3. Hinge: Continuous type.
 - 4. Latches: Bolt type, operated by either a ring turn or flush key device (keyed alike).
 - 5. Fire-Protection Rating for Walls: 1-1/2 hours.
- B. Flush Access Doors with Exposed Trim: Units consisting of frame with exposed trim, door, hardware, and complying with the following requirements:
 - 1. Frame: 0.0598-inch- (1.52-mm-) thick zinc-coated steel sheet.
 - 2. Door: 0.0747-inch- (1.90-mm-) thick zinc-coated steel sheet.
 - 3. Trim: Flange integral with frame, 3/4 inch (19 mm) wide, overlapping surrounding finished surface.
 - 4. Hinge: Continuous type.
 - 5. Locks: Flush, screwdriver-operated cam.
- C. Trimless, Flush Access Doors for Gypsum Board: Units consisting of frame, concealed edge trim, door, hardware, and complying with the following requirements:
 - 1. Frame: 0.0598-inch- (1.52-mm-) thick zinc-coated steel sheet.
 - 2. Door: 0.0747-inch- (1.90-mm-) thick zinc-coated steel sheet.
 - 3. Concealed, Gypsum Board Edge Trim: 0.0299-inch (0.76-mm) zinc-coated or galvanized-steel sheet with face flange formed to receive joint compound.
 - 4. Hinge: Concealed spring pin or continuous type.
 - 5. Locks: Screwdriver-operated cam.

2.4 FABRICATION

- A. General: Manufacture each access door assembly as an integral unit ready for installation.
- B. Steel Access Doors and Frames: Continuous welded construction. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 - 1. Exposed Flange: Nominal 1 to 1-1/2 inches (25.4 to 38.1 mm) wide around perimeter of frame.
 - 2. For gypsum board assemblies, furnish frames with edge trim for gypsum board or gypsum base.
 - 3. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.
- C. Locking Devices: Furnish number required to hold door in flush, smooth plane when closed.
 - 1. For cylinder lock, furnish 2 keys per lock and key all locks alike.

PART 3 - EXECUTION

3.1 PREPARATION

A. Advise Installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices. Furnish inserts and anchoring devices for access doors that must be built into other construction. Coordinate delivery with other work to avoid delay.

3.2 INSTALLATION

A. Comply with manufacturer's instructions for installing access doors.

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- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finished surfaces.
- C. Install concealed-frame access doors flush with adjacent finish surfaces.

3.3 ADJUST AND CLEAN

- A. Adjust hardware and panels after installation for proper operation.
- B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083050

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
 - Division 08 Section "Flush Wood Doors".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC International Building Code.
 - 3. NFPA 70 National Electrical Code.
 - 4. NFPA 80 Fire Doors and Windows.
 - NFPA 101 Life Safety Code.
 - 6. NFPA 105 Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
 - 1. ANSI/BHMA Certified Product Standards A156 Series
 - 2. UL10C Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

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- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- D. Informational Submittals:
 - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
- E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 - 3. Review sequence of operation narratives for each unique access controlled opening.
 - 4. Review and finalize construction schedule and verify availability of materials.

- 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:

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- 1. Seven years for heavy duty cylindrical (bored) locks and latches.
- 2. Five years for exit hardware.
- 3. Ten years for manual surface door closer bodies.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" heavy weight.

- 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
- 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
- 5. Manufacturers:
 - a. Bommer Industries (BO).
 - b. Hager Companies (HA).
 - c. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cutouts.
 - Manufacturers:
 - a. Bommer Industries (BO).
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
 - c. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
 - 1. Manufacturers:
 - a. Corbin Russwin Hardware (RU).
- C. Cylinders: Original manufacturer cylinders complying with the following:
 - 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
 - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 - 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

- 5. Keyway: Match Facility Standard.
- D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
 - 1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- E. Keying System: Each type of lock and cylinders to be factory keyed.
 - 1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
 - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 - 3. Existing System: Key locks to Owner's existing system.
- F. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Three (3).
 - 2. Master Keys (per Master Key Level/Group): Five (5).
 - 3. Construction Keys (where required): Ten (10).
 - 4. Construction Control Keys (where required): Two (2).
 - 5. Permanent Control Keys (where required): Two (2).
- G. Construction Keying: Provide construction master keyed cylinders.
- H. Construction Keying: Provide temporary keyed construction cores.
- I. Key Registration List (Bitting List):
 - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 - 2. Provide transcript list in writing or electronic file as directed by the Owner.
- J. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
 - 1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).
- K. Key Control Software: Provide one network version of "Key Wizard" branded key management software package that includes one year of technical support and upgrades to software at no charge. Provide factory key system formatted for importing into "Key Wizard" software.

2.4 MECHANICAL LOCKS AND LATCHING DEVICES

- Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.
 - 1. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at paired openings) throw brass or stainless steel latchbolt.
 - 2. Locks are to be non-handed and fully field reversible.
 - 3. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.2 requirements to 2 million cycles.
 - 4. Manufacturers:
 - a. Corbin Russwin Hardware (RU) CL3300 Series.
 - b. No Substitution.

2.5 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 - 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 - 4. Dustproof Strikes: BHMA A156.16.

2.6 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 - 1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 - 2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the

- proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
- 3. Except on fire rated doors, provide exit devices with key cylinder dogging device to hold the pushbar and latch in a retracted position.
- 4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
- 5. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
- 6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
- 7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
- 8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
- 9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
- 10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
- 11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
 - 1. Manufacturers:
 - a. Sargent Manufacturing (SA) 80 Series.
 - b. No Substitution.

2.7 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 - 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

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- Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
- 3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
- 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
- 5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
- 6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
- 7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 certified surface mounted, high efficiency door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.
 - 1. Manufacturers:
 - a. Corbin Russwin (RU) DC5000 Series.
 - b. Norton Door Controls (NO) 2800ST Series.
 - c. Sargent Manufacturing (SA) 422 Series.

2.8 ARCHITECTURAL TRIM

A. Door Protective Trim

- 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
- 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
- 3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
- 4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:

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- a. Stainless Steel: 300 grade, 050-inch thick.
- 5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
- 6. Manufacturers:
 - a. Burns Manufacturing (BU).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).

2.9 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Manufacturers:
 - a. Burns Manufacturing (BU).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - 1. Manufacturers:
 - a. Rixson Door Controls (RF).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Sargent Manufacturing (SA).

2.10 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

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- 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

- 1. National Guard Products (NG).
- 2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
- 3. Reese Enterprises, Inc. (RE).

2.11 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.12 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

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B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and 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 specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

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3.5 ADJUSTING

A. Initial Adjustment: 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.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. The supplier is responsible for handing and sizing all products and providing the correct option for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.
- C. Manufacturer's Abbreviations:
 - 1. MK McKinney
 - 2. PE Pemko
 - 3. RO Rockwood
 - 4. RU Corbin Russwin
 - 5. RF Rixson
 - 6. NO Norton

Hardware Sets

Set: 1.0

Door: 101,103,201 & 203

Description: Restroom

3	Hinge (heavy weight)	T4A3386 (qty, size, nrp per spec)	US32D	MK
1	Classroom Lock	CL3355 NZD	626	RU
1	Surface Closer (cam action)	2800ST; PS2800ST	689	NO
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	401; 404; 441CU (or per spec)	US26D	RO
1	Head & Jamb Seal (adhesive)	S88BL		PE

Set: 2.0

Door: 102,104,202 & 204

Description: Jan Closet

3 Hinge (heavy weight)	T4A3786 (qty, size, nrp per spec)	US26D	MK
1 Storeroom Lock	CL3357 NZD	626	RU
1 Door Stop	401; 404; 441CU (or per spec)	US26D	RO
3 Silencer	608		RO

END OF SECTION 087100

SECTION 087200 SEALS-THRESHOLDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Commercial Thresholds
- B. Related Sections:
 - 1. Division 9 Wood Gymnasium Flooring

1.02 REFERENCES

- A. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
 - 1. ANSI/BHMA A156.18: Materials and Finishes.
 - 2. ANSI/BHMA A156.21 Thresholds.
- B. Underwriters Laboratories, Inc. (UL):
 - 1. UL 10B Fire Tests of Door Assemblies.
 - 2. UL 10C Fire Tests of Door Assemblies.
 - 3. UL 410 Slip Resistance for Floor Surface Materials.
- C. Federal Government:
 - 1. U.S. Architectural & Transportation Barriers Compliance Board. Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG), 1992.
 - Federal Standard FED-STD-795-1988 (Revised 1989) Uniform Federal Accessibility Standards.
- D. International Code Council (ICC):
 - 1. International Building Code (IBC) Code 2009 (Positive Pressure).
 - 2. ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements: Provide threshold and seal products which have been manufactured, fabricated and installed to meet the following design criteria:
 - 1. Compliant with UL 410.
 - 2. Compliant with ADA standards.

1.04 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit manufacturer's product data and installation instructions.
- C. Shop Drawings: Provide drawings indicating required component locations, interface with adjacent materials, installation, anchorage, fastening and similar information.
- D. Samples: Submit one each of manufacturer's standard selection samples.

1.05 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

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C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.06 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
 - 1. Warranty Period: 3 years against defects in materials or workmanship, beginning with Date of Substantial Completion.

1.07 MAINTENANCE

A. Extra Materials: Provide additional material for use by owner in building maintenance and repair.

PART 2 PRODUCTS

2.01 THRESHOLDS

- A. Manufacturer: Equal to Pemko Manufacturing Company.
 - Contact: PO Box 3780, 4226 Transport Street, Ventura, CA 93003; Telephone: (800) 283-9988, (805) 642-2600; Fax: (805) 642-4109; E-mail: pemkosales@pemko.com; website: www.pemko.com.
- B. Systems: Thresholds, including the following:
 - 1. Saddle Thresholds:
 - a. Material: Extruded tempered aluminum 6063-T6.
 - b. Finish (ANSI/BHMA 156.18): Mill finish aluminum
 - 2. Floor Closer Thresholds and Cover Plate Assemblies:
 - a. Material: Extruded tempered aluminum 6063-T6.
 - b. Finish (ANSI/BHMA 156.18): Mill finish aluminum
 - 3. Floor Plate Supports and Accessories:
 - a. Material: Extruded tempered aluminum 6063-T6.
 - b. Finish (ANSI/BHMA 156.18): Mill finish aluminum.
 - c. Expansion Joint: Cork.
 - 4. Aluminum Plates:
 - a. Material: Extruded tempered aluminum 6063-T6.
 - b. Finish (ANSI/BHMA 156.18): Mill finish aluminum

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with the instructions and recommendations of the threshold manufacturer.

3.02 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Verify that site conditions are acceptable for installation of thresholds.
 - a. Examine doors and frames for compliance with requirements for door and frame manufacturer's installation tolerances, labeled fire door assembly construction, wall and floor construction and other conditions affecting performance.
 - 2. Do not proceed with the installation of thresholds until unacceptable conditions are corrected.

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3.03 INSTALLATION

- A. Mounting Location: Comply with drawings and approved shop drawings.
- B. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
- C. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

3.04 ADJUSTING

A. Perform adjustments required to ensure that thresholds function in compliance with manufacturer's performance criteria prior to acceptance by Owner.

3.05 CLEANING

A. Remove any protective films and clean components as necessary following manufacturer's recommended procedures.

3.06 PROTECTION

A. Protect installed work from damage due to subsequent construction activity on the site.

END OF SECTION

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SECTION 092600 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum wallboard.
 - 2. Tile backing panels.
 - 3. Non-load-bearing steel framing.

1.3 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- D. Product certificates signed by manufacturers of gypsum board assembly components certifying that their products comply with specified requirements.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility:
 - 1. Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated
 - 2. Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer
 - 3. Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.
- B. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."
- C. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
- D. Gypsum Board Finish Mockups: Before finishing gypsum board assemblies, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and qualities of materials and execution.

 Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturers written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - Steel Framing and Furring:
 - a. Clark Steel Framing Systems.
 - b. Consolidated Systems, Inc.
 - c. Dale Industries, Inc. Dale/Incor.
 - d. Dietrich Industries, Inc.
 - e. MarinoWare; Division of Ware Ind.
 - f. National Gypsum Company.
 - g. Scafco Corporation.
 - h. Unimast, Inc.
 - i. Western Metal Lath & Steel Framing Systems.
 - j. Approved equal
 - 2. Gypsum Board and Related Products:
 - a. American Gypsum Co.
 - b. G-P Gypsum Corp.
 - c. National Gypsum Company.
 - d. United States Gypsum Co.
 - e. Approved equal

2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Components, General: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire.
- C. Hanger Attachments to Concrete: As follows:
 - Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to five (5) times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
 - a. Type: Post-installed, expansion anchor.
 - Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosionresistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to ten (10) times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.

- D. Hangers: As follows:
 - 1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
 - 2. Rod Hangers: ASTM A 510, mild carbon steel.
 - a. Diameter: 1/4-inch.
 - . Protective Coating: ASTM A 153/A 153M, hot-dip galvanized.
 - 3. Flat Hangers: Commercial-steel sheet, ASTM A 653/A 653M, G40, hot-dip galvanized
 - a. Size: 1 by 3/16 inch by length indicated.
 - 4. Angle Hangers: ASTM A 653/A 653M, G90, hot-dip galvanized commercial-steel sheet.
 - a. Minimum Base Metal Thickness: 0.0312 inch.
 - b. Size: 2 by 2 inches.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch-wide flange, with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
 - 1. Depth: 2-1/2 inches.
- F. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
 - 1. Cold Rolled Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange, 3/4 inch deep.
 - 2. Steel Studs: ASTM C 645.
 - a. Minimum Base Metal Thickness: 0.0312 inch.
 - b. Depth: 3-5/8 inches.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base Metal Thickness: 0.0312 inch.
 - 4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
- G. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
 - b. Chicago Metallic Corporation.
 - c. USG Interiors, Inc.; Drywall Suspension System.
 - d. Approved Equal

2.3 STEEL PARTITION AND SOFFIT FRAMING

- A. Components, General: As follows:
 - 1. Comply with ASTM C 754 for conditions indicated.
 - 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with manufacturer's standard corrosion-resistant zinc coating.
- B. Steel Studs and Runners: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0312 inch. (20 GA minimum.)
 - 2. Depth: As indicated.
- C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- deep flanges.
- D. Proprietary Deflection Track: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above; in thickness indicated for studs and in width to accommodate depth of studs.
 - 1. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Product: Subject to compliance with requirements, provide one of the following:
 - a. Delta Star, Inc., Superior Metal Trim; Superior Flex Track System (SFT).
 - b. Metal-Lite, Inc.; Slotted Track.
 - c. Approved Equal

- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - Minimum Base Metal Thickness: 0.0312 inch.
 - 2. Retain paragraph and subparagraphs below for channel bridging for fixture attachment or lateral bracing. Indicate locations and details of installation on Drawings.
- F. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange.
 - 1. Depth: 1-1/2 inches.
 - 2. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch- thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0312 inch.
 - 2. Depth: 7/8 inch.
- H. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
 - 1. Configuration: Asymmetrical or hat shaped, with face attached to single flange by a slotted leg (web) or attached to two flanges by slotted or expanded metal legs.
- I. Cold-Rolled Furring Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange.
 - 1. Depth: 3/4 inch.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch.
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire.
- J. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
- K. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.4 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
 - 1. Provide gypsum board in widths of 48 inches (1219 mm).
- B. Gypsum Wallboard: ASTM C 36.
 - 1. Regular Type:
 - a. Thickness: 5/8 inch, unless otherwise indicated.
 - b. Long Edges: Tapered.
 - c. Location: As indicated.
 - 2. Impact Resistant Type
 - a. Thickness: 5/8 inch, unless otherwise indicated.
 - b. Long Edges: Tapered.
 - c. Location: As indicated.
 - d.

2.5 TILE BACKING PANELS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
 - 1. Widths: Provide gypsum board in widths of 48 inches (1219 mm).
- B. Cementitious Backer Units: ANSI A118.9.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide [one of] the following:

- a. Custom Building Products; Wonderboard.
- b. FinPan. Inc.: Util-A-Crete Concrete Backer Board.
- c. United States Gypsum Co.; DUROCK Cement Board.
- d. Approved Equal.
- 3. Thickness: As indicated.

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Plastic formed or galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead: Use at outside corners, unless otherwise indicated.
 - b. Bullnose Bead: Use where indicated.
 - c. LC-Bead: for edge trim unless otherwise indicated.
 - d. L-Bead: L-shaped; exposed long leg receives joint compound; use where indicated.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound; use where indicated.
 - f. Expansion (Control) Joint: Use where indicated.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges; use at curved openings.
- B. Exterior Trim: ASTM C 1047.
 - 1. Material: Hot-dip galvanized steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead: Use at outside corners.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening. Use where indicated.
- C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - Available Manufacturers: Subject to compliance with requirements, manufacturers offering
 products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. MM Systems Corporation.
 - d. Pittcon Industries.
 - e. Approved equal.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

- D. Joint Compound for Exterior Applications:
 - Exterior Gypsum Soffit Board: Use setting-type taping and setting-type, sandable topping compounds.
- E. Joint Compound for Tile Backing Panels:
 - 1. Cementitious Backer Units: As recommended by manufacturer.

2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002. unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick
 - For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Thermal Insulation: As specified in Division 7 Section "Building Insulation."
- F. Polyethylene Vapor Retarder: As specified in Division 7 Section "Building Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devises indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754 and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.

- 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
- 2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install sliptype joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
 - a. Use deep-leg deflection track where indicated.
 - b. Use proprietary deflection track where indicated.
 - c. Use proprietary firestop track where indicated.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Suspend ceiling hangers from building structure as follows:
 - Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 - 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
 - 4. Secure rod, flat and angle hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 6. Do not attach hangers to steel deck tabs.
 - 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.
- C. Sway-brace suspended steel framing with hangers used for support.
- D. For exterior soffits, install cross bracing and framing to resist wind uplift.
- E. Wire-tie furring channels to supports as required.
- F. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
- G. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
 - 1. Where studs are installed directly against exterior walls, install asphalt-felt or foam-gasket isolation strip between studs and wall.

- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 - For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
 - a. Terminate partition framing at suspended ceilings where indicated.
- D. Install steel studs and furring at the following spacings:
 - 1. Single-Layer Construction: 16 inches o.c., unless otherwise indicated.
 - 2. Multilayer Construction: 16 inches o.c., unless otherwise indicated.
 - 3. Cementitious Backer Units: 16 inches o.c., unless otherwise indicated.
- E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- F. Curved Partitions:
 - Cut top and bottom track (runners) through leg and web at 2-inch intervals for arc length. In cutting lengths of track, allow for uncut straight lengths of not less than 12 inches at ends of arcs.
 - 2. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - 3. Support outside (cut) leg of track by clinching steel sheet strip, 1-inch- high-by-thickness of track metal, to inside of cut legs using metal lock fasteners.
 - 4. Begin and end each arc with a stud, and space intermediate studs equally along arcs at stud spacing recommended in writing by gypsum board manufacturer for radii indicated. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches o.c.
- G. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1. Install two studs at each jamb, unless otherwise indicated.
 - 2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
 - 3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- H. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

I.

- J. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches o.c.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
 - 4. Until gypsum board is installed, hold insulation in place with 10-inch staples fabricated from 0.0625-inch- diameter, tie wire and inserted through slot in web of member.

- K. Polyethylene Vapor Retarder: Install to comply with requirements specified in Division 7 Section "Building Insulation."
- 3.6 APPLYING AND FINISHING PANELS, GENERAL
 - A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
 - B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
 - C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
 - D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
 - E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
 - F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
 - G. Attach gypsum panels to framing provided at openings and cutouts.
 - H. Form control and expansion joints with space between edges of adjoining gypsum panels.
 - I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
 - J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
 - K. Floating Construction: Where feasible, including where recommended in writing by manufacturer, install gypsum panels over wood framing, with floating internal corner construction.
 - L. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
 - M. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
 - 1. Space screws a maximum of 12 inches o.c. for vertical applications.
 - N. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.7 PANEL APPLICATION METHODS

A. Single-Layer Application:

- 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
- 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - Stagger abutting end joints not less than one framing member in alternate courses of board
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
- 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- B. Multilayer Application on Ceilings: Apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
- C. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - 1. Z-Furring Members: Apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
- D. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- E. Multilayer Fastening Methods: [Fasten base layers and face layers separately to supports with screws] [Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners].
- F. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

G. Curved Partitions:

- 1. Install panels horizontally and unbroken, to the extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
- 2. Wet gypsum panels on surfaces that will become compressed where curve radius prevents using dry panels. Comply with gypsum board manufacturers written recommendations for curve radii, wetting methods, stacking panels after wetting, and other preparations that precede installing wetted gypsum panels.
- 3. On convex sides of partitions, begin installation at one end of curved surface and fasten gypsum panels to studs as they are wrapped around curve. On concave side, start fastening panels to stud at center of curve and work outward to panel ends. Fasten panels to framing with screws spaced 12 inches o.c.
- 4. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.
- 5. Allow wetted gypsum panels to dry before applying joint treatment.
- H. Exterior Soffits and Ceilings: Apply exterior gypsum soffit board panels perpendicular to supports, with end joints staggered and located over supports.
 - 1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.

- 2. Fasten with corrosion-resistant screws.
- I. Tile Backing Panels:
 - 1. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
 - 2. Areas Not Subject to Wetting: Install standard gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.
 - 3. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.8 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturers written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings.

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 - 1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - 2. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 - 1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
 - 2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.
 - f. Installation of ceiling support framing.

g.

3.11 CLEANING AND PROTECTION

A. Promptly remove any residual joint compound from adjacent surfaces.

B.	Provide final protection and maintain conditions, in a manner acceptable to installer, that ensure
	gypsum board assemblies are without damage or deterioration at the time of substantial completion.

a.

b.

c.

END OF SECTION 092600

SECTION 093100 - CERAMIC TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Ceramic mosaic tile.
 - 2. Glazed wall tile.
 - 3. Waterproof membrane for thin-set and thick-set tile installations.
 - 4. Stone thresholds installed as part of tile installations.

1.3 DEFINITIONS

- A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.
- B. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
 - 1. Level Surfaces: Minimum 0.6.
- B. Load-Bearing Performance: For ceramic tile installed on walkway surfaces, provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:
 - 1. Heavy: Passes cycles 1 through 12.
 - 2. Moderate: Passes cycles 1 through 10.

1.5 SUBMITTALS

- A. Product Data: For each type of tile, mortar, grout, and other products specified.
- B. Shop Drawings: For the following:
 - 1. Tile patterns and locations.
 - 2. Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Tile Samples for Initial Selection: Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.
- D. Grout Samples for Initial Selection: Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.
- E. Samples for Verification: Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.
 - 1. Each type and composition of tile and for each color and texture required, at least 12 inches (300 mm) square, mounted on braced cementitious backer units, and with grouted joints using

- product complying with specified requirements and approved for completed work in color or colors selected by Architect.
- 2. Full-size units of each type of trim and accessory for each color required.
- 3. Stone thresholds in 6-inch (150-mm) lengths.
- F. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- G. Product Certificates: Signed by manufacturers certifying that the products furnished comply with requirements.
- H. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of architects and owners, and other information specified.
- I. Setting Material Test Reports: Indicate and interpret test results for compliance of tile-setting and grouting products with specified requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful inservice performance.
- B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
- D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:
 - 1. Stone thresholds.
 - 2. Joint sealants.
 - 3. Waterproofing.
- E. Mockups: Before installing tile, construct mockups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for completed Work.
 - 1. Locate mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect 7 days in advance of the dates and times when mockups will be constructed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before proceeding with final unit of Work.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are 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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the ceramic tile installation schedules at the end of this Section.
 - 1. Tile Products:
 - a. Dal-Tile Corporation.
 - b. GranitiFiandre.
 - c. United States Ceramic Tile Company.
 - d. Or approved equal.
 - 2. Tile-Setting and -Grouting Materials:
 - a. Dal-Tile Corporation.
 - b Laticrete International, Inc.
 - c. Mapei Corporation.
 - d. Or approved equal.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
 - 2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.
- C. Colors, Textures, and Patterns: Where manufacturer's standard and custom products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

- Match Architect's samples, to be selected from manufacturer's standard and premium colors and textures.
- 2. Provide tile trim and accessories that match color and finish of adjoining flat tile.
- 3. Allow for up to 20% of tile to be accent colors.
- D. Factory Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.
- E. Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.

2.3 TILE PRODUCTS

- A. Unglazed Ceramic Mosaic Floor Tile: Provide factory-mounted flat tile complying with the following requirements:
 - 1. Composition: 12X12 Square– Mesh Mounted Harmonist Celestia HM30 Matte
 - 2. Module Size: 12"x12"
 - 3. Nominal Thickness: 1/4 inch (6.35 mm).
 - 4. Face: Square Mosaic
- B. Glazed Wall Tile: Provide flat tile complying with the following requirements:
 - Module Size: 6 by 6 inches (152 by 152 mm).
 - 2. Thickness: 5/16 inch (8 mm).
 - 3. Face: Pattern of design indicated, with manufacturer's standard edges.
 - 4. Mounting: Factory back-mounted.
- C. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with the following requirements:
 - 1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
 - 2. Shapes: As follows, selected from manufacturer's standard shapes:
 - a. Base for Portland Cement Mortar Installations: Coved.
 - b. Base for Thin-Set Mortar Installations: Straight.
 - c. Wainscot Cap for Portland Cement Mortar Installations: Bullnose cap.
 - d. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose.
 - e. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above.
 - f. External Corners for Portland Cement Mortar Installations: Bullnose shape with a radius of at least 3/4 inch (19 mm), unless otherwise indicated.
 - g. External Corners for Thin-Set Mortar Installations: Surface bullnose.
 - h. Internal Corners: Field-butted square corners, except with coved base and cap angle pieces designed to member with stretcher shapes.

2.4 STONE THRESHOLDS

- A. General: Provide stone thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces.
 - 1. Fabricate thresholds to heights indicated, but not more than 1/2 inch (12.7 mm) above adjoining finished floor surfaces, with transition edges beveled on a slope of no greater than 1:2.
- B. Marble Thresholds: Provide marble thresholds complying with ASTM C 503 requirements for exterior use and with a minimum abrasive-hardness value of 10 per ASTM C 241.
 - 1. Provide white, honed marble complying with the Marble Institute of America's Group A requirements for soundness.

2.5 WATERPROOFING FOR THIN-SET TILE INSTALLATIONS

A. General: Provide products that comply with ANSI A118.10 and the descriptions in this Article.

NOTE: Water proofing required for all ceramic tile floor conditions.

- B. Sheet Membrane Waterproofing: Manufacturer's standard factory-packaged, 3-layer composite sheet membrane waterproofing and crack isolation. Comprised of Chlorinated Polyethylene with a high-strength, non-woven fabric laminated to both sides. Designed to provide waterproofing and crack isolation in tile installations. Also allows tile to bridge control joints. Nominal thickness: 0.8 mm.
- C. Available Products: Subject to compliance with requirements, products which may be incorporated into the Work include, but are not limited to, the following:
 - 1. Sheet Membrane Waterproofing:
 - a. Dal-Seal TS; DalTile, Inc.
 - b. Or approved equal.

2.6 GROUTING MATERIALS

A. Sanded Grout and joint filler, Laticrete Floor Grout & Joint Filler, 500 Series for joints greater than 1/8" thickness. Color to be selected by Architect from manufacturer's standard range of colors.

2.7 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
- B. Provide concrete substrates for tile floors installed with dry-set or latex-portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.

- 1. Use trowelable leveling and patching compounds per tile-setting material manufacturer's written instructions to fill cracks, holes, and depressions.
- 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- C. Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. 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.
- E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.
- F. Lay out tile wainscots to next full tile beyond dimensions indicated.
- G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
 - 2. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."
- H. Grout tile to comply with the requirements of the following tile installation standards:
 - 1. For ceramic tile grouts (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts), comply with ANSI A108.10.

3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing membrane to comply with waterproofing manufacturer's written instructions. Membrane to be installed at all ceramic tile floors with floor drains in wet areas, including all toilet rooms, showers and all other tiled areas as required.
- B. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.5 FLOOR TILE INSTALLATION

- A. General: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing TCA installation methods and ANSI A108 series of tile installation standards.
- B. Joint Widths: Install tile on floors with the following joint widths:
 - 1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).
- C. Back Buttering: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
 - 1. Tile floors in wet areas, including showers, tub enclosures, laundries.
 - 2. Tile floors composed of tiles 8 by 8 inches (203 by 203 mm) or larger.
 - 3. Tile floors composed of rib-backed tiles.
- D. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
 - 1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.

3.6 WALL TILE INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.
- B. Joint Widths: Install tile on walls with the following joint widths:
 - 1. Wall Tile: 1/16 inch (1.6 mm).
- C. Back Buttering: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
 - 1. Tile wall installations in wet areas, including showers, tub enclosures, laundries.

3.7 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - Remove latex-portland cement grout residue from tile as soon as possible.
 - 2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.
 - 1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
 - 2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.
- E. Provide grout sealer, per grout manufacturer's recommendations, at all tile and grout surfaces.

3.8 TILE INSTALLATION SCHEDULE

NOTE:

All the tiles and types are manufactured or supplied by Dal-Tile or Architect approved equal. All CMU walls scheduled for the tile must receive a mortar scratch coat prior to the tile installation.

A. Toilet Rooms

a. Floors:

Daltile 12x12 Square - HARMONIST CELESTIA HM30 MATTE BULLNOSE: DALTILE S44C9 4X12

b. Base:

Ceramic tile: 6"x6" Ceramic Tile with SCHULTER STRIP: MATTE SUEDE GRAY COVE BASE 0782

c. Walls

Paint: GWB to receive painted finish, Willams SW7658 GRAY CLOUDS Ceramic Tile: Daltile 6"x6" Square- Matte Suede Gray 0782 Matte

Notes:

- 1. Tile patterns and configurations will be given to the awarded contractor prior to tile purchase and installation.
- 2. All areas receiving floor tile are to receive continuous tile cove base. No cut tiles will be accepteable at base.
- 3. Marble saddles are required at all bathroom thresholds and at all floor finish changes. Including between shower rooms and toilet rooms.

END OF SECTION 093100

SECTION 095110 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes ceilings consisting of acoustical panels and exposed suspension systems.

1.3 SUBMITTALS

- A Product Data: For each type of product specified.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of actual acoustical panels or sections of acoustical panels, suspension systems, and moldings showing the full range of colors, textures, and patterns available for each type of ceiling assembly indicated.
- C. Samples for Verification: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
 - 1. 6 -inch square samples of each acoustical panel type, pattern, and color.
 - 2. Set of 12-inch long samples of exposed suspension system members, including moldings, for each color and system type required.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.
- F. Research/Evaluation Reports: Evidence of acoustical panel ceiling's and components' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

- 1. Fire-response tests were performed by UL, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
- 2. Products are identified with appropriate markings of applicable testing and inspecting agency.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent of amount installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated for each designation in the Acoustical Panel Ceiling Schedule at the end of Part 3.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - 1. Mounting Method for Measuring Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15/32 away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

- 1. Where appearance characteristics of acoustical panels are indicated by referencing ASTM E 1264 pattern designations and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range of products that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Panel Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3, including those referencing ASTM E 1264 classifications.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.016 inch diameter wire.
- E. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
 - For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 - 2 At sloped acoustical ceiling conditions, provide custom bent edge molding at angle of ceiling along high and low points of room. Size, profile, and finish to match manufacturer's standard edge molding.
- F. Hold-Down Clips for Non-Fire-Resistance-Rated Ceilings: For interior ceilings consisting of acoustical panels weighing less than 1 lb./s.f., provide hold-down clips spaced 24 inches o.c. on all cross tees.
- G. Where sloped acoustical ceilings occur at classrooms, provide shims, as required per manufacturer recommendations, along lower side of T-Bar to assure tile sits symmetrically in grid.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
 - 2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 3. Do not support ceilings directly from permanent metal forms or floor deck.
 - Do not attach hangers to steel deck tabs.
 - 5. Space hangers not more than 48-inches o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8-inches from ends of each member.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16-inches o.c. and not more than 3-inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 2. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.6 ACOUSTICAL PANEL CEILING SCHEDULE

- A. Type II Acoustical Panel Ceiling: Provide at all storage rooms, mechanical rooms, janitors closets and utility spaces not publically accesible.
 - 1. Products: Available products include the following
 - a. Armstrong ceiling panels Model #1728(24X24)), Fine Fissured (medium texture), or approved equal.
 - 1) Material: Wet-formed mineral fiber
 - 2) Surface Finish: Factory applied vinyl laytex paint
- 2. Classification: Panels fitting ASTM E 1264 for type and form as follows
 - a. Type III, Form 2, Pattern CE;
 - 3. Color: White
 - 4. Light Reflectance Coefficient: Not less than LR 0.84.
 - 5. Noise Reduction Coefficient: NRC 0.55.
 - 6. Ceiling Attenuation Class: Not less than CAC 33.
 - 7. Edge Detail: Square lay-in.
 - 8. Thickness: 5/8 inch.
 - 9. Size: 24 by 24 inches
 - b. Typical Standard Suspension System of Acoustical Panel Ceilings: Where this designation is indicated, provide acoustical panel ceiling suspension system complying with the following:
 - 1. Products: Available products include the following
 - a. Armstrong, Exposed Tee Systems; (White) Prelude 15/16" or approved equal
 - 2. 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 according to ASTM A 653/653M, G01 coating designation, with prefinished 15/16-inch wide metal caps on flanges; other characteristics as follows:
 - a. Structural Classification: Intermediate-duty system.
 - b. End Condition of Cross Runners: Butt-edge type, as standard with manufacturer. Override (stepped) type.
 - c. Face Design: Painted white.
 - d. Cap Material: Aluminum sheet as standard with manufacturer.
 - e. Cap Finish: Painted white.

END OF SECTION 095110

SECTION 096780 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Resilient wall base.
 - 2. Resilient flooring accessories.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - Division 9 Section "Resilient Tile Flooring."

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. Samples for initial selection purposes of manufacturer's standard sample sets in form of pieces cut from each type of product specified showing full range of colors and patterns available.
- D. Product certificates, in lieu of laboratory test reports when permitted by Architect, signed by manufacturer certifying that each product complies with requirements.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Products: Obtain each type and color of product specified from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- B. Fire Performance Characteristics: Provide products with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: 0.45 watts per sq cm or more per ASTM E 648.
 - 2. Smoke Density: Less than 450 per ASTM E 662.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in original manufacturer's unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).
- C. Move products into spaces where they will be installed at least 48 hours in advance of installation.

1.6 PROJECT CONDITIONS

A. Maintain a minimum temperature of 70 deg F (21 deg C) in spaces to receive products specified in this Section for at least 48 hours prior to installation, during installation, and for not less than 48 hrs after installation. After this period, maintain a temperature of not less than 55 deg F (13 deg C).

- B. Do not install products until they are at the same temperature as that of the space where they are to be installed.
- C. Close spaces to traffic during installation of products specified in this Section.

1.7 SEQUENCING AND SCHEDULING

A. Sequence installing products specified in this Section with other construction to minimize possibility of damage and soiling during remainder of construction period.

1.8 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.
 - Furnish not less than 10 linear feet (3 linear meters) for each 500 linear feet (150 linear meters) or fraction thereof of each different type and color of resilient wall base installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, those specified in each Product Data Sheet at end of this Section.

2.2 RESILIENT WALL BASE

A. Vinyl Wall Base: Products complying with FS SS-W-40, Type II, and requirements specified in the Vinyl Wall Base Product Data Sheet at end of this Section.

2.3 RESILIENT ACCESSORIES

A. Vinyl Accessories: Products complying with requirements specified in Vinyl Accessory Product Data Sheet at end of this Section.

2.4 INSTALLATION ACCESSORIES

- A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.
- B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- Adhesives: Water-resistant type recommended by manufacturer to suit resilient flooring product and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where installation of products specified in this Section will occur, with Installer present, to verify that substrates and conditions are satisfactory for installation and comply with manufacturer's requirements and those specified in this Section.

3.2 PREPARATION

- A. General: Comply with manufacturer's installation specifications for preparing substrates indicated to receive products indicated.
- B. Use trowelable leveling and patching compounds per manufacturers directions to fill cracks, holes, and depressions in substrates.

- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
- D. Broom or vacuum clean substrates to be covered immediately before installing products specified in this Section. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.
- E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

3.3 INSTALLATION

- A. General: Install products specified in this Section using methods indicated according to manufacturer's installation directions.
- B. Apply resilient wall base to walls, columns, pilasters, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 1. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - 2. Install inside and exterior corners before installing straight pieces.
- C. Place resilient accessories so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.
- D. Apply resilient accessories to stairs as indicated and according to manufacturer's installation instructions.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing installation:
 - Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers of resilient product involved.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor until after time period recommended by manufacturer.
 - Damp-mop resilient accessories to remove black marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by manufacturer of resilient product involved.
 - 1. Cover resilient accessories on floors and stairs with undyed, untreated building paper until inspection for Substantial Completion.
- C. Clean products specified in this Section not more than 4 days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products using method recommended by manufacturer.

PRODUCT DATA SHEET 1 - VINYL WALL BASE

1. A.Vinyl Wall Base Designation: WB

B. Style: Straight with toe.

C.Minimum Thickness: 0.080 inch (2 mm).

D.Height: 4 inches (100 mm).

E.Lengths: Cut lengths 48 inches (1200 mm) long or Coils in lengths standard with manufacturer but not less than 96 feet (29 m).

F.Surface Characteristics: Smooth.

G.Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns produced for vinyl wall base complying with requirements indicated.

Products: Roppe or approved equal.

2. Schluter® -DILEX-PHK

- A. Description: Pre-colored rigid PVC profile with integrated trapezoidperforated anchoring leg, connected at a 90-degree angle by a coveshaped section with 3/8" (10 mm) radius that forms the visible surface.
- B. Corners: a. Provide with matching inside corners b. Provide with matching outside corners c. Provide with matching end caps d. Provide with matching connectors
- C. Material and Finish: a. BW Bright White b. W White c. SP Sand Pebble d. BH Bahama e. HB Light Beige f. PG Classic Grey g. G Grey

3. Or approved equal

PRODUCT DATA SHEET 2 - VINYL ACCESSORY

- A. Vinyl Accessory Designation: VA
- B. Product Description: Reducer strip for resilient flooring.
- C. Profile and Dimensions: As specified by product designation below.
- D. Color: As selected by Architect from manufacturer's full range of colors Produced for vinyl accessories complying with requirements indicated.
- E. Products: Roppe or approved equal.

END OF SECTION 096780

SECTION 097720 -FIBERGLASS REINFORCED WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Prefinished polyester glass reinforced plastic sheets and adhered to unfinished gypsum wallboard.
 - 1. PVC trim.
 - 2. PVC Wall base.
- B. Products Not Furnished or Installed under This Section:
 - 1. Gypsum substrate board.
 - Resilient Base.
- C. American Society for Testing and Materials: Standard Specifications (ASTM)
 - 1. ASTM D 256 Izod Impact Strengths (ft #/in)
 - 2. ASTM D 570 Water Absorption (%)
 - 3. ASTM D 638 Tensile Strengths (psi) & Tensile Modulus (psi)
 - 4. ASTM D 790 Flexural Strengths (psi) & Flexural Modulus (psi)
 - 5. ASTM D 2583- Barcol Hardness
 - 6. ASTM D 5319 Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
 - 7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.2 SUBMITTALS

- A. Product Data: Submit sufficient manufacturer's data to indicate compliance with these specifications, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Shop Drawings: Submit elevations of each wall showing location of paneling and trim members with respect to all discontinuities in the wall elevation.
- C. Selection Samples: Submit manufacturer's standard color pattern selection samples representing manufacturer's full range of available colors and patterns.
- D. Samples for Verification: Submit appropriate section of panel for each finish selected indicating the color, texture, and pattern required.
 - 1. Submit complete with specified applied finish.
 - 2. For selected patterns show complete pattern repeat.
 - 3. Exposed Molding and Trim: Provide samples of each type, finish, and color.
 - E. Manufacturers Material Safety Data Sheets (MSDS) for adhesives, sealants and other pertinent materials prior to their delivery to the site.

1.3 QUALITY ASSURANCE

- A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:
 - 1. ASTM E 84 (Method of test for surface burning characteristics of building Materials)
 - a. Wall Required Rating Class A
- B. Sanitary Standards: System components and finishes to comply with:
 - United States Department of Agriculture (USDA) requirements for food preparation facilities, incidental contact.
 - 2. Food and Drug Administration (FDA) 1999 Food Code 6-101.11.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials factory packaged on strong pallets.
- B. Store panels and trim lying flat, under cover and protected from the elements. Allow panels to acclimate to room temperature (range of 60 to 75°F) for 48 hours prior to installation.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Building are to be fully enclosed prior to installation with sufficient heat (70°) and ventilation consistent with good working conditions for finish work
- B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
 - 1. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

1.6 WARRANTY

A. Furnish one year guarantee against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Marlite; 1 Marlite Drive, Dover, OH 44622. 800-377-1221 FAX (330) 343-4668 Email: info@marlite.com www.marlite.com.
- B. Architect Approved Equal
- C. Product:
 - Standard FRP

2.2 PANELS

- A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
 - 1. Coating: Multi-layer print, primer and finish coats or applied over-layer.
 - 2. Dimensions:
 - a. Thickness 0.090 " nominal
 - b. Width 4'-0" nominal
 - c. Length 10'-0" nominal
 - 3. Tolerance:
 - a. Length and Width: +/-1/8 "
 - b. Square Not to exceed 5/32 "for 10 foot panels
- B. Properties: Resistant to rot, corrosion, staining, denting, peeling, and splintering.
 - 1. Flexural Strength 1.0 x 10⁴ psi per ASTM D 790.
 - 2. Flexural Modulus 3.1 x 10⁵ psi per ASTM D 790.
 - 3. Tensile Strength 7.0 x 10³ psi per ASTM D 638.
 - 4. Tensile Modulus 1.6 x 10⁵ psi per ASTM D 638.
 - 5. Water Absorption 0.72% per ASTM D 570.
 - 6. Barcol Hardness (scratch resistance) of 35 55 as per ASTM D 2583.
 - 7. Izod Impact Strength of 72 ft. lbs./in ASTM D 256
- C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.
 - a. Color and Finish:
 - 1) To be selected form manufacturers standard color and finish selections.
 - b. Size:
 - 1) 48" x 120" x .090" nom.

2.3 BASE

- A. Base Molding for 0.090" thick FRP Panels
 - Color: To be selected form manufacturers standard colors
 - 2. Profiles:
 - a. FRP Base Molding, 10' length
 - b. Inside Corner
 - c. Outside Corner
 - d. LH End Cap
 - e. RH End Cap
- B. Cove Base Molding for .090" thick FRP Panels
 - 1. Color: Color selected from manufacturers standard range
 - 2. Profile: [V65 Base Cove]

2.4 MOLDINGS

- A. PVC Trim: Thin-wall semi-rigid extruded PVC.
 - 1. Inside Corner, 10' length
 - 2. Outside Corner, 10' length
 - 3. Division, 10' length
 - 4. Edge, 10' length
 - 5. 135° Inside Corner 8' length
 - 6. 135° Outside Corner 8' length

- 7. Color: Color selected from manufacturers standard range
- B. SaniSeal Trim: Co-extruded, dual-durometer polypropylene/monprene profiles with Dual-Seal Technology and high-performance pressure sensitive adhesive.
 - 1. Inside Corner, 10' length
 - 2. Outside Corner, 10' length
 - 3. Division, 8' length
 - 4. Edge, 10' length
 - 5. Color: Color selected from manufacturers standard range
- C. Outside Corner Guard:
 - 1. Stainless Corner Guard, 10' length-To be installed 6' A.F.F. at all outside corners
 - 2. Finish: #4 brushed satin

2.5 ACCESSORIES

- A. Fasteners: Non-staining nylon drive rivets.
 - 1. Match panel colors.
 - 2. Length to suit project conditions.
- B. Adhesive: Either of the following construction adhesives complying with ASTM C 557.
 - 1. FRP Adhesive Water- resistant, non-flammable adhesive.
 - 2. Construction Adhesive Flexible, water-resistant, solvent based adhesive, formulated for fast, easy application.
 - 3. Titebond Advanced Polymer Panel Adhesive VOC compliant, non-flammable, environmentally safe adhesive.
- C. Sealant:
 - 1. Clear Silicone Sealant.
 - 2. White Silicone Sealant.
 - Color Match Sealant.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
 - 1. Verify that stud spacing does not exceed 24" (61cm) on-center.
- B. Repair defects prior to installation.
 - Level wall surfaces to panel manufacturer's requirements. Remove protrusions and fill indentations.

3.2 INSTALLATION

A. Comply with manufacturer's recommended procedures and installation sequence.

- B. Cut sheets to meet supports allowing 1/8" (3 mm) clearance for every 8 foot (2.4m) of panel.
 - 1. Cut and drill with carbide tipped saw blades or drill bits, or cut with shears.
 - 2. Pre-drill fastener holes 1/8" (3mm) oversize with high speed drill bit.
 - a. Space at 8" (200mm) maximum on center at perimeter, approximately 1" from panel edge.
 - b. Space at in field in rows 16' (40.64cm) on center, with fasteners spaced at 12" (30.48 cm) maximum on center.
- C. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.
 - 1. Install panels with manufacturer's recommended gap for panel field and corner joints.
 - a. Adhesive trowel and application method to conform to adhesive manufacturer's recommendations.
 - b. Drive fasteners for snug fit. Do not over-tighten.
- Apply panel moldings to all panel edges using silicone sealant providing for required clearances.
 - 1. All moldings must provide for a minimum 1/8 " (3mm) of panel expansion at joints and edges, to insure proper installation.
 - 2. Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

3.3 CLEANING

- A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.
- B. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.

END OF SECTION 097720

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.
 - 1. Concrete.
 - 2. Clay masonry.
 - 3. Concrete masonry units (CMU).
 - 4. Steel.
 - 5. Cast iron.
 - Galvanized metal.
 - 7. Aluminum (not anodized or otherwise coated).
 - 8. Wood.
 - 9. Gypsum board.
 - 10. Plaster.
 - 11. Spray-textured ceilings.
 - 12. Cotton or canvas insulation covering.
 - 13. ASJ insulation covering.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523, a matte flat finish.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, a high-side sheen flat, velvet-like finish.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523, a satin-like finish.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.

- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. VOC content.

1.5 CLOSEOUT SUBMITTALS

A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.7 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer's label with the following information:
 - 1. Product name and type (description).
 - 2. Batch date.
 - 3. Color number.
 - 4. VOC content.
 - 5. Environmental handling requirements.
 - 6. Surface preparation requirements.
 - 7. Application instructions.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company products indicated or comparable product from one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Duron, Inc.
 - 3. Glidden Professional, Division of PPG Architectural Finishes, Inc.
 - 4. PPG Architectural Finishes, Inc.
 - Pratt & Lambert.
- B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.
 - 1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

- 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Dry-Fog Coatings: 400 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
 - 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
 - 8. Floor Coatings: 100 g/L.
 - 9. Shellacs, Clear: 730 g/L.
 - 10. Shellacs, Pigmented: 550 g/L.
- C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Colors: As selected by Architect from manufacturer's full range
 - 1. 10 percent of surface area will be painted with deep tones.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

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. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.

1. Report, in writing, conditions that may affect application, appearance, or performance of paint.

B. Substrate Conditions:

- Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
 - c. Wood: 15 percent.
 - d. Gypsum Board: 12 percent.
 - e. Plaster: 12 percent.
- 2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- 3. Plaster Substrates: Verify that plaster is fully cured.
- 4. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates 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.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 03732.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

- 1. SSPC-SP 2, "Hand Tool Cleaning."
- 2. SSPC-SP 3, "Power Tool Cleaning."
- 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint the following work where exposed in occupied spaces:
 - Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces and Clay Masonry:
 - 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - d. Topcoat: Latex, interior, low sheen: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - e. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - f. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - g. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - 2. Water-Based Light Industrial Coating System:
 - Prime Coat: Primer sealer, latex, interior: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - Topcoat: Light industrial coating, interior, water based, eggshell: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - 3. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."
 - 4. Concrete Stain System (Water-based) for Vertical Surfaces:
 - a. First Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
 - b. Second Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
- B. Concrete Substrates, Pedestrian Traffic Surfaces:
 - 1. Latex Floor Enamel System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.
 - 2. Clear Acrylic System, Gloss Finish:

- a. First Coat: S-W H&C Concrete Sealer Wet Look Water Base, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
- b. Second Coat: S-W H&C Concrete Sealer Wet Look Water Base, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).

3. Concrete Stain System (Water-based):

- a. First Coat: Low-luster opaque finish: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
- b. Second Coat: Low-luster opaque finish: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per I).
- 4. Epoxy and Urethane Coatings: Refer to Section 099600 "High-Performance Coatings."
- 5. Epoxy- and Urethane- Based Aggregate-Filled Floor Surfacing: Refer to Section 09 67 23 "Resinous Flooring."

C. CMU Substrates:

1. Latex System:

- a. Block Filler: Block filler, latex, interior/exterior: S-W PrepRite Block Filler, B25W25, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, flat: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- d. Topcoat: Latex, interior, low sheen: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- e. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- f. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- g. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

2. Water-Based Light Industrial Coating System:

- a. Block Filler: Block filler, latex, interior/exterior: S-W PrepRite Block Filler, B25W25, at 100 to 200 sg. ft. per gal (2.4 to 4.9 sg. m per l).
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, eggshell: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
- d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

3. Concrete Stain System (Water-based):

- a. First Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
- Second Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).

- 4. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."
- 5. Epoxy and Urethane Coatings: Refer to Section 099600 "High-Performance Coatings."

D. Metal Substrates (Aluminum, Steel, Galvanized Steel):

1. Latex System:

- a. Prime Coat: Primer, rust-inhibitive, water based: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.
- b. Intermediate Coat: Water-based acrylic, interior, matching topcoat.
- c. Topcoat: Water-based acrylic, semi-gloss: S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.
- d. Topcoat: Water-based acrylic, gloss: S-W Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils dry, per coat.

2. Water-Based Dry-Fall System:

- a. Top Coat: Dry-fall latex, flat: S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-80 Series, at 6.0 mils wet, 1.7 mils dry.
- b. Top Coat: Dry-fall latex, eggshell: S-W Pro Industrial Waterborne Acrylic DryFall Eg-Shel, B42-2 Series, at 6.0 mils wet, 1.9 mils dry.
- c. Top Coat: Dry-fall latex, semi-gloss: S-W Pro Industrial Waterborne Acrylic DryFall Semi-Gloss, B42-80 Series, at 5.8 mils wet, 2.3 mils dry.

3. Water-Based Light Industrial Coating System:

- a. Prime Coat: Primer, rust-inhibitive, water based: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10.0 mils wet, 2.0 to 4.0 mils dry.
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, eggshell: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
- d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
- 4. Two-Component Epoxy and Epoxy High Build Systems: Refer to Section 099600 "High-Performance Coatings."
- 5. Acrylic/Alkyd System:
 - a. Prime Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10.0 mils wet, 2.0 to 4.0 mils dry.
 - b. Intermediate Coat: Water-based acrylic-alkyd, interior, matching topcoat.
 - Topcoat: Water-based acrylic-alkyd, semi-gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Semi-Gloss, B34-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - d. Topcoat: Water-based acrylic-alkyd, gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Gloss, B35-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

E. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.

1. Latex System:

- a. Prime Coat: Primer sealer, latex, interior: S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils wet, 1.4 mils dry.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- d. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- e. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

2. Acrylic/Alkyd System:

- a. Prime Coat: Primer sealer, latex, interior: S-W Premium Wall & Wood Primer, B28W8111, at 4.0 mils wet, 1.8 mils dry.
- b. Intermediate Coat: Water-based acrylic-alkyd, interior, matching topcoat.
- c. Topcoat: Water-based acrylic-alkyd, semi-gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Semi-Gloss, B34-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- d. Topcoat: Water-based acrylic-alkyd, gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Gloss, B35-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- 1. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer sealer, latex, interior: S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils wet, 1.4 mils dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
- 2. Two-Component Epoxy and Epoxy High Build Systems: Refer to Section 099600 "High-Performance Coatings."
- F. Wood Substrates, Pedestrian Traffic Surfaces:
 - 1. Latex Floor Enamel System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.
- G. Gypsum Board, Plaster and Spray-Texture Ceiling Substrates:
 - 1. Latex System:
 - a. Prime Coat: Primer, latex, interior: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

- d. Topcoat: Latex, interior, low sheen: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- e. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- f. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- g. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

2. Water-Based Light Industrial Coating System:

- a. Prime Coat: Primer sealer, latex, interior: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, eggshell: S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
- d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

END OF SECTION 099123

SECTION 101550 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes solid-polymer units as follows:
 - 1. Toilet Enclosures: Overhead braced and Floor anchored.
 - 2. Entrance Screens: Overhead braced and Floor anchored.
 - 3. Urinal Screens: Wall hung, Floor anchored, and Post supported.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
- C. Samples for Initial Selection: For each type of unit indicated.
- D. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.
 - Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 SOLID-POLYMER UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products equal to one of the following:
 - 1. Accurate Partitions Corporation.
 - 2. Ampco.
 - 3. Bradley Corporation; Mills Partitions.
 - 4. Capitol Partitions, Inc.
 - 5. Comtec Industries.
 - 6. General Partitions Mfg. Corp.
 - 7. Global Steel Products Corp.
 - 8. Metpar Corp.
 - 9. Santana Products, Inc.
 - 10. Sanymetal; a Crane Plumbing Company.
 - 11. Weis-Robart Partitions, Inc.

- B. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) or polypropylene (PP) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range of colors and patterns.
- C. Pilaster Shoes: Manufacturer's standard design; stainless steel.
 - 1. Polymer Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns.

D. Brackets (Fittings):

- 1. Stirrup Type: Ear or U-brackets, stainless steel.
- 2. Full-Height (Continuous) Type: Manufacturer's standard design.
 - a. Polymer Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns.
- E. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
- F. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

2.2 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - 1. Material: Stainless steel.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Support Posts for Urinal Screens: Manufacturer's standard aluminum post with floor shoe for anchoring to floor construction.
- D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- C. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.
- D. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

- E. Doors: Unless otherwise indicated, provide in-swinging doors for standard toilet compartments and 36-inch- wide out-swinging doors with a minimum 32-inch- wide clear opening for compartments indicated to be accessible to people with disabilities.
 - 1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
 - 2. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
 - 3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
 - 4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors and entrance screen doors.
 - 5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 3/4 inch.
 - 2. Stirrup Brackets: Secure panels to walls and to pilasters with not less than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor, unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- D. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.
- E. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.
- F. Wall-Hung and Post-Supported Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 101550

SECTION 108000 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes toilet and bath accessory items as scheduled.

1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.
- B. Product data for each toilet accessory item specified, including construction details relative to materials, dimensions, gages, profiles, mounting method, specified options, and finishes.
- C. Setting drawings where cutouts are required in other work, including templates, substrate preparation instructions, and directions for preparing cutouts and installing anchorage devices.
- D. Maintenance instructions including replaceable parts and service recommendations.

1.4 QUALITY ASSURANCE

- A. Inserts and Anchorages: Furnish accessory manufacturers' standard inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.
- B. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.

1.5 PROJECT CONDITIONS

A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

1.6 WARRANTY

- A. Warranty: Submit a written warranty executed by mirror manufacturer, agreeing to replace any mirrors that develop visible silver spoilage defects within warranty period.
- B. Warranty Period: 15 years from date of Substantial Completion.
- C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide toilet accessories by one of the following:
 - 1. American Specialties, Inc.
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corporation.
 - 4. Or approved equal.

2.2 MATERIALS, GENERAL

- A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 0.034 inch (0.9 mm) minimum thickness.
- B. Mirror Glass: Nominal 6.0 mm thick, conforming to ASTM C 1036, Type I, Class 1, Quality q2, and with silvering, electro- plated copper coating, and protective organic coating.
- C. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.
- D. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.
- E. Refer to Project Drawings for Accessory Schedules and Installation Locations.

2.3 FABRICATION

- A. General: Only a maximum 1-1/2 inch (38 mm) diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by either a printed, waterproof label or a stamped nameplate, indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.
- C. Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors or access panels with full-length, stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.
- D. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent moisture accumulation, as follows:
 - 1. Provide galvanized-steel backing sheet, not less than 0.034 inch (0.9 mm) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.
- E. Mirror Unit Hangers: Provide system for mounting mirror units that will permit rigid, tamperproof, and theftproof installation, as follows:

- Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
- F. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install toilet accessory units according to manufacturers' instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.
- B. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer's instructions for type of substrate involved.
- C. Install grab bars to withstand a downward load of at least 250 lbf (1100 N), complying with ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
- B. Clean and polish all exposed surfaces strictly according to manufacturer's recommendations after removing temporary labels and protective coatings.

TOILET AND BATH ACCESSORIES SCHEDULE

All items specified are by Bobrick, (or approved equal, unless otherwise noted).

A. Refer to drawing drawings for toilet accessory schedule.

END OF SECTION 108000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - Sleeves.
 - 6. Escutcheons.
 - 7. Grout
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Concrete bases.
 - 11. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.

- 2. CPVC: Chlorinated polyvinyl chloride plastic.
- 3. PE: Polyethylene plastic.
- 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - Dielectric fittings.
 - Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.5 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 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 manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

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: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. 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.
 - PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Eslon Thermoplastics.

- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - Available Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - Available Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.5 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 (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers:

- a. Capitol Manufacturing Co.
- b. Central Plastics Company.
- c. Epco Sales, Inc.
- d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.

- 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- 3. Pressure Plates: Carbon steel. Include two for each sealing element.
- Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating] of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) 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.

2.8 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] [Rough brass] [Polished chrome-plated and rough brass].
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 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 (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 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 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 according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsumboard partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) 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.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 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.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 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 leadfree 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.
 - 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.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) 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.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- Install equipment to allow maximum possible headroom unless specific mounting heights are not 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.

3.5 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. 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 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.

3.9 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 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. Bronze angle valves.
- 2. Brass ball valves.
- 3. Bronze ball valves.
- 4. Iron ball valves.
- 5. Iron, single-flange butterfly valves.
- 6. Iron, grooved-end butterfly valves.
- 7. Bronze lift check valves.
- 8. Bronze swing check valves.
- 9. Iron swing check valves.
- 10. Iron swing check valves with closure control.
- 11. Iron, grooved-end swing check valves.
- 12. Iron, center-guided check valves.
- 13. Iron, plate-type check valves.
- 14. Bronze gate valves.
- 15. Iron gate valves.
- 16. Bronze globe valves.
- 17. Iron globe valves.
- 18. Lubricated plug valves.
- 19. Chainwheels.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to 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. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch (50-mm) 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.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
 - 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. Hammond Valve.
 - b. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.
- B. Class 125, Bronze Angle Valves with Nonmetallic Disc:

- 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. American Valve, Inc.
 - b. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- C. Class 150, Bronze Angle Valves with Bronze Disc:
 - 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. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Kitz Corporation.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.
- D. Class 150, Bronze Angle Valves with Nonmetallic Disc:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - 2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRASS BALL VALVES

- A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:
 - 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:
 - Kitz Corporation.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: One piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.
- B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. Kitz Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - I. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.
- C. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - d. Hammond Valve.
 - e. Jamesbury; a subsidiary of Metso Automation.
 - f. Kitz Corporation.
 - g. Marwin Valve; a division of Richards Industries.
 - h. Milwaukee Valve Company.
 - i. RuB Inc.

- a. Standard: MSS SP-110.
- SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.
- D. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:
 - 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. Hammond Valve.
 - b. Jamesbury; a subsidiary of Metso Automation.
 - c. Legend Valve.
 - d. Marwin Valve; a division of Richards Industries.

- e. Milwaukee Valve Company.
- f.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Regular.
- E. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:
 - 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. Jamesbury; a subsidiary of Metso Automation.
 - b. Marwin Valve; a division of Richards Industries.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Brass or bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Regular.
- F. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:
 - 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. Jomar International, LTD.
 - b. Kitz Corporation.
 - c. Red-White Valve Corporation.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.

- b. SWP Rating: 150 psig (1035 kPa).c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.
- G. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
 - 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. Jomar International, LTD.
 - b. Kitz Corporation.
 - c. Marwin Valve; a division of Richards Industries.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Three piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.4 BRONZE BALL VALVES

- A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:
 - 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. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig (2760 kPa).

- c. Body Design: One piece.
- d. Body Material: Bronze.
- e. Ends: Threaded.
- f. Seats: PTFE or TFE.
- g. Stem: Bronze.
- h. Ball: Chrome-plated brass.
- i. Port: Reduced.
- B. One-Piece, Reduced-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 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. Conbraco Industries, Inc.; Apollo Valves.
 - b. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig (4140 kPa).
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Reduced.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 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. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - 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.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.
- E. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:
 - 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. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. DynaQuip Controls.
 - f. Hammond Valve.
 - g. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - 2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- 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: Regular.
- F. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Regular.
- G. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 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. Conbraco Industries, Inc.; Apollo Valves.
 - b. DynaQuip Controls.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).

- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.
- H. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.5 IRON BALL VALVES

- A. Class 125, Iron Ball Valves:
 - 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. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Kitz Corporation.
 - d. Sure Flow Equipment Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- a. Standard: MSS SP-72.
- b. CWP Rating: 200 psig (1380 kPa).

- c. Body Design: Split body.
- d. Body Material: ASTM A 126, gray iron.
- e. Ends: Flanged.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel.
- i. Port: Full.

2.6 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - 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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Flo Fab Inc.
 - h. Hammond Valve.
 - i. Kitz Corporation.
 - j. Legend Valve.
 - k. Milwaukee Valve Company.
 - I. NIBCO INC.
 - m. Norriseal; a Dover Corporation company.
 - n. Red-White Valve Corporation.
 - o. Spence Strainers International; a division of CIRCOR International, Inc.
 - p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.
- B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:
 - 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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.

- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- d. Crane Co.; Crane Valve Group; Jenkins Valves.
- e. Crane Co.; Crane Valve Group; Stockham Division.
- f. DeZurik Water Controls.
- g. Flo Fab Inc.
- h. Hammond Valve.
- i. Kitz Corporation.
- j. Legend Valve.
- k. Milwaukee Valve Company.
- I. NIBCO INC.
- m. Norriseal; a Dover Corporation company.
- n. Red-White Valve Corporation.
- o. Spence Strainers International; a division of CIRCOR International, Inc.
- p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.
- C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
 - 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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. American Valve, Inc.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - e. Crane Co.; Crane Valve Group; Center Line.
 - f. Crane Co.: Crane Valve Group: Stockham Division.
 - g. DeZurik Water Controls.
 - h. Flo Fab Inc.
 - i. Hammond Valve.
 - j. Kitz Corporation.
 - k. Legend Valve.
 - I. Milwaukee Valve Company.
 - m. Mueller Steam Specialty; a division of SPX Corporation.
 - n. NIBCO INC.
 - o. Norriseal; a Dover Corporation company.
 - p. Spence Strainers International; a division of CIRCOR International, Inc.
 - q. Sure Flow Equipment Inc.
 - r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated or -coated ductile iron.
- D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:
 - 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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. American Valve, Inc.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - e. Crane Co.; Crane Valve Group; Center Line.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. DeZurik Water Controls.
 - h. Flo Fab Inc.
 - i. Hammond Valve.
 - j. Kitz Corporation.
 - k. Legend Valve.
 - I. Milwaukee Valve Company.
 - m. Mueller Steam Specialty; a division of SPX Corporation.
 - n. NIBCO INC.
 - o. Norriseal; a Dover Corporation company.
 - p. Spence Strainers International; a division of CIRCOR International, Inc.
 - q. Sure Flow Equipment Inc.
 - r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated or -coated ductile iron.
- E. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
 - 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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. American Valve, Inc.

- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- e. Crane Co.; Crane Valve Group; Jenkins Valves.
- f. Crane Co.; Crane Valve Group; Stockham Division.
- g. DeZurik Water Controls.
- h. Flo Fab Inc.
- i. Hammond Valve.
- j. Kitz Corporation.
- k. Legend Valve.
- I. Milwaukee Valve Company.
- m. Mueller Steam Specialty; a division of SPX Corporation.
- n. NIBCO INC.
- o. Norriseal; a Dover Corporation company.
- p. Red-White Valve Corporation.
- q. Spence Strainers International; a division of CIRCOR International, Inc.
- r. Sure Flow Equipment Inc.
- s. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Stainless steel.
- F. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:
 - 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. ABZ Valves and Controls; A div. of ABZ Manufacturing, Inc.
 - b. American Valve, Inc.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Cooper Cameron Valves: A div. of Cooper Cameron Corp.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Div.
 - g. DeZurik Water Controls.
 - h. Flo Fab Inc.
 - i. Hammond Valve.
 - j. Kitz Corporation.
 - k. Legend Valve.
 - I. Milwaukee Valve Company.
 - m. Mueller Steam Specialty; a division of SPX Corporation.
 - n. NIBCO INC.
 - o. Norriseal: a Dover Corporation company.
 - p. Red-White Valve Corporation.
 - q. Spence Strainers International; a division of CIRCOR International, Inc.
 - r. Sure Flow Equipment Inc.

- s. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.

2.7 IRON, GROOVED-END BUTTERFLY VALVES

- A. 175 CWP, Iron, Grooved-End Butterfly Valves:
 - 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. Kennedy Valve; a division of McWane, Inc.
 - b. Shurjoint Piping Products.
 - c. Tyco Fire Products LP; Grinnell Mechanical Products.
 - d. Victaulic Company.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig (1200 kPa).
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.
- B. 300 CWP, Iron, Grooved-End Butterfly Valves:
 - 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. Anvil International, Inc.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. NIBCO INC.
 - e. Shurjoint Piping Products.
 - f. Tyco Fire Products LP; Grinnell Mechanical Products.
 - g. Victaulic Company.
 - 2. Description:

- a. Standard: MSS SP-67, Type I.
- b. NPS 8 (DN 200) and Smaller CWP Rating: 300 psig (2070 kPa).
- c. NPS 10 (DN 250) and Larger CWP Rating: 200 psig (1380 kPa).
- d. Body Material: Coated, ductile iron.
- e. Stem: Two-piece stainless steel.
- f. Disc: Coated, ductile iron.
- g. Seal: EPDM.

2.8 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Bronze Disc:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- B. Class 125, Lift Check Valves with Nonmetallic Disc:
 - 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. Flo Fab Inc.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. Mueller Steam Specialty; a division of SPX Corporation.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.

f. Disc: NBR, PTFE, or TFE.

2.9 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 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. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - I. Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 4.

- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.
- C. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - 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. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.10 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Sure Flow Equipment Inc.
 - I. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.
- B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. < Insert manufacturer's name>.

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Composition.
- g. Seat Ring: Bronze.
- h. Disc Holder: Bronze.

- i. Disc: PTFE or TFE.
- Gasket: Asbestos free.
- C. Class 250, Iron Swing Check Valves with Metal Seats:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.11 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
 - 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. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and spring.
- B. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:

- 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.
- h. Closure Control: Factory-installed, exterior lever and weight.

2.12 IRON, GROOVED-END SWING CHECK VALVES

- A. 300 CWP, Iron, Grooved-End Swing Check Valves:
 - 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. Anvil International, Inc.
 - b. Shurjoint Piping Products.
 - c. Tyco Fire Products LP; Grinnell Mechanical Products.
 - d. Victaulic Company.

2. Description:

- a. CWP Rating: 300 psig (2070 kPa).
- b. Body Material: ASTM A 536, ductile iron.
- c. Seal: EPDM.
- d. Disc: Spring-operated, ductile iron or stainless steel.

2.13 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - 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. Anvil International, Inc.
- b. APCO Willamette Valve and Primer Corporation.
- c. Crispin Valve.
- d. DFT Inc.
- e. Flo Fab Inc.
- f. GA Industries, Inc.
- g. Hammond Valve.
- h. Metraflex, Inc.
- i. Milwaukee Valve Company.
- j. Mueller Steam Specialty; a division of SPX Corporation.
- k. NIBCO INC
- I. Spence Strainers International; a division of CIRCOR International, Inc.
- m. Sure Flow Equipment Inc.
- n. Val-Matic Valve & Manufacturing Corp.
- o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Compact wafer.
- e. Seat: Bronze.
- B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Flomatic Corporation.
 - e. Hammond Valve.
 - f. Metraflex, Inc.
 - g. Milwaukee Valve Company.
 - h. Mueller Steam Specialty; a division of SPX Corporation.
 - i. NIBCO INC.
 - j. Spence Strainers International; a division of CIRCOR International, Inc.
 - k. Sure Flow Equipment Inc.
 - I. Val-Matic Valve & Manufacturing Corp.
 - m. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: Bronze.

- C. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer.
 - e. Seat: Bronze.
- D. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.
- E. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Metraflex, Inc.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Sure Flow Equipment Inc.

- j. Val-Matic Valve & Manufacturing Corp.
- 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: Bronze.
- F. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Flomatic Corporation.
 - e. Hammond Valve.
 - f. Metraflex, Inc.
 - g. Milwaukee Valve Company.
 - h. Mueller Steam Specialty; a division of SPX Corporation.
 - i. NIBCO INC.
 - j. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.
- G. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer, spring loaded.

- e. Seat: Bronze.
- H. Class 300, Iron, Globe, Center-Guided Check Valves with Metal Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.
- I. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Spence Strainers International; a division of CIRCOR International, Inc.
 - i. Sure Flow Equipment Inc.
 - j. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer.
 - e. Seat: EPDM.
- J. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - 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. Anvil International, Inc.
- b. APCO Willamette Valve and Primer Corporation.
- c. Crispin Valve.
- d. DFT Inc.
- e. GA Industries, Inc.
- f. Hammond Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Sure Flow Equipment Inc.
- j. Val-Matic Valve & Manufacturing Corp.
- 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM.
- K. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer.
 - e. Seat: EPDM.
- L. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.

- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: EPDM.
- M. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Sure Flow Equipment Inc.
 - i. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: EPDM.
- N. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM.

- O. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: EPDM.
- P. Class 300, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM.

2.14 IRON, PLATE-TYPE CHECK VALVES

- A. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Flomatic Corporation.
 - d. Mueller Steam Specialty; a division of SPX Corporation.
 - 2. Description:

- a. Standard: API 594.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 126, gray iron.
- e. Seat: Bronze.
- B. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Seat: Bronze.
- C. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: Bronze.
- D. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. Val-Matic Valve & Manufacturing Corp.

- 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Seat: Bronze.
- E. Class 125, Iron, Single-Plate Check Valves with Resilient Seat:
 - 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. Flo Fab Inc.
 - b. Sure Flow Equipment Inc.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Wafer, spring-loaded plate.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: EPDM.
- F. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Cooper Cameron Valves TVB Techno.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. NIBCO INC.
 - f. Spence Strainers International; a division of CIRCOR International, Inc.
 - g. Sure Flow Equipment Inc.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: EPDM.
- G. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:

- 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. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Val-Matic Valve & Manufacturing Corp.
- 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
- H. Class 250, Iron, Wafer, Single-Plate Check Valves with Resilient Seat:
 - 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. Sure Flow Equipment Inc.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: Wafer, spring-loaded plate.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: EPDM.
- I. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:
 - 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. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Sure Flow Equipment Inc.
 - 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: EPDM.
- J. Class 300, Iron, Dual-Plate Check Valves with Resilient Seat:

- 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. APCO Willamette Valve and Primer Corporation.
 - b. Val-Matic Valve & Manufacturing Corp.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- e. Seat: EPDM.

2.15 BRONZE GATE VALVES

- A. Class 125, NRS Bronze Gate Valves:
 - 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. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - I. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.
- B. Class 125, RS Bronze Gate Valves:

- 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. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, NRS Bronze Gate Valves:

- 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. Hammond Valve.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Powell Valves.
 - f. Red-White Valve Corporation.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

D. Class 150, RS Bronze Gate Valves:

- 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - i. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

2.16 IRON GATE VALVES

- A. Class 125, NRS, Iron Gate Valves:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Legend Valve.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Powell Valves.
 - k. Red-White Valve Corporation.
 - I. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.
 - 2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

- 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Legend Valve.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Powell Valves.
 - k. Red-White Valve Corporation.
 - I. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

C. Class 250, NRS, Iron Gate Valves:

- 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 500 psig (3450 kPa).

- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

D. Class 250, OS&Y, Iron Gate Valves:

- 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Powell Valves.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

2.17 BRONZE GLOBE VALVES

- A. Class 125, Bronze Globe Valves with Bronze Disc:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - j. Zy-Tech Global Industries, Inc.
 - 2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.
- B. Class 125, Bronze Globe Valves with Nonmetallic Disc:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
 - d. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- C. Class 150, Bronze Globe Valves with Nonmetallic Disc:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Powell Valves.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - i. Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.

- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

2.18 IRON GLOBE VALVES

- A. Class 125, Iron Globe Valves:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.
- B. Class 250, Iron Globe Valves:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-85, Type I.

- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

2.19 LUBRICATED PLUG VALVES

- A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 - 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. Nordstrom Valves, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
 - 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. Nordstrom Valves, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 - 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. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

- a. Standard: MSS SP-78, Type IV.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular or short Venturi.
- e. Plug: Cast iron or bronze with sealant groove.
- D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:
 - 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. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- E. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 - 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. Nordstrom Valves, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- F. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
 - 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. Nordstrom Valves, Inc.

2. Description:

- a. Standard: MSS SP-78, Type II.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular or short Venturi.
- e. Plug: Cast iron or bronze with sealant groove.
- G. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 - 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. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

- a. Standard: MSS SP-78, Type IV.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular or short Venturi.
- e. Plug: Cast iron or bronze with sealant groove.
- H. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:
 - 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. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

- a. Standard: MSS SP-78, Type IV.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
- d. Pattern: Regular or short Venturi.
- e. Plug: Cast iron or bronze with sealant groove.

2.20 CHAINWHEELS

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. Babbitt Steam Specialty Co.
- 2. Roto Hammer Industries.
- Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to ball, butterfly and plug valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
 - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

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 chainwheels on operators for valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.

3. Lift Check Valves: With stem upright and plumb.

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, butterfly, or gate valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Globe, ball, or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves
 - c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- 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 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
 - 7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 125, bronze disc.
 - 3. Ball Valves: Two piece, full port, brass or bronze with brass trim.
 - 4. Bronze Swing Check Valves: Class 125, bronze disc.

- 5. Bronze Gate Valves: Class 125, NRS.
- 6. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

- 1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
- 2. Iron Ball Valves: Class 150.
- 3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, ductile-iron disc.
- 4. Iron, Grooved-End Butterfly Valves: 175 CWP.
- 5. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
- 6. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
- 7. Iron, Grooved-End Swing Check Valves: 300 CWP.
- 8. Iron, Center-Guided Check Valves: Class 125, compact-wafer, resilient seat.
- 9. Iron, Plate-Type Check Valves: Class 125; single plate; resilient seat.
- 10. Iron Gate Valves: Class 125, OS&Y.
- 11. Iron Globe Valves: Class 125.

3.6 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

- Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends
- 2. Bronze Angle Valves: Class 125, bronze disc.
- 3. Ball Valves: Two piece, full port, brass or bronze with brass trim.
- 4. Bronze Swing Check Valves: Class 125, bronze disc.
- 5. Bronze Gate Valves: Class 125, NRS.
- 6. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

- 1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
- 2. Iron Ball Valves: Class 150.
- 3. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
- 4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
- 5. Iron, Grooved-End Swing Check Valves: 300 CWP.
- 6. Iron, Center-Guided Check Valves: Class 125, compact-wafer, resilient seat.
- 7. Iron, Plate-Type Check Valves: Class 125; single plate; resilient seat.
- 8. Iron Gate Valves: Class 125, OS&Y.
- 9. Iron Globe Valves: Class 125.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- Metal pipe hangers and supports.
- 2. Trapeze pipe hangers.
- 3. Fiberglass pipe hangers.
- 4. Metal framing systems.
- 5. Fiberglass strut systems.
- 6. Thermal-hanger shield inserts.
- 7. Fastener systems.
- 8. Pipe stands.
- 9. Pipe positioning systems.
- 10. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

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

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.
- D. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Structural Steel 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.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:

- 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
- 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers:
 - 1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
 - 2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass.
- B. Strap-Type, Fiberglass Pipe Hangers:
 - 1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
 - 2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.4 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 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. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - 3. Standard: MFMA-4.
 - 4. Channels: Continuous slotted steel channel with inturned lips.
 - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 - 7. Metallic Coating: Hot-dipped galvanized.
 - 8. Paint Coating: Vinyl.
 - 9. Plastic Coating: PVC.

B. Non-MFMA Manufacturer Metal Framing Systems:

- 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. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.
- 2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
- 3. Standard: Comply with MFMA-4.
- 4. Channels: Continuous slotted steel channel with inturned lips.
- 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- 7. Coating: Zinc.

2.5 FIBERGLASS STRUT SYSTEMS

- 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. Allied Tube & Conduit.
 - Champion Fiberglass, Inc.
 - 3. Cooper B-Line, Inc.
 - 4. SEASAFE, INC.; a Gibraltar Industries Company.
- B. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.
 - 1. Channels: Continuous slotted fiberglass channel with inturned lips.
 - 2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.6 THERMAL-HANGER SHIELD INSERTS

- 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. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.
 - 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

- 7. Piping Technology & Products, Inc.
- 8. Rilco Manufacturing Co., Inc.
- 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa), ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Plastic.
 - Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuousthread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

- 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
- 2. Bases: One or more; plastic.
- Vertical Members: Two or more protective-coated-steel channels.
- 4. Horizontal Member: Protective-coated-steel channel.
- 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.9 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.10 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.11 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-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 (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal 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 the building structure.
- B. Metal 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.
 - Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 - Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:

- 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.
- I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and 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.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. 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 (DN 65) 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.
- O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- Q. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 - 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 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 so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are 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 carbon-steel pipe hangers and supports with attachments for general service applications.
- F. Use copper-plated pipe hangers and attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. 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 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 - 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.

- 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
- Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
- 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. 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 24 (DN 24 to DN 600).
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- L. 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-joist 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 - 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

- 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
- 12. 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 (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
- 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. 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.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- Equipment labels.
- 2. Warning signs and labels.
- Pipe labels.
- 4. Stencils.
- 5. Valve tags.
- 6. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

- 1. Material and Thickness: Brass, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
- 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- 3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 4. Fasteners: Stainless-steel rivets or self-tapping screws.
- 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

- 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
- 2. Letter Color: Black
- 3. Background Color: Yellow.
- 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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.
- C. 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.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) 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 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.

- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. 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 (38 mm) high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard or metal.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

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.

3.3 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.

- 2. Stencil Paint: Use for pipe marking.
- B. 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.
 - 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 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches (38 mm), round.
 - b. Hot Water: 1-1/2 inches (38 mm), round.
 - 2. Valve-Tag Color:
 - a. Cold Water: Green.
 - b. Hot Water: Green.
 - 3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - Calcium silicate.
 - b. Cellular glass.
 - c. Flexible elastomeric.
 - d. Mineral fiber.
 - e. Phenolic.
 - f. Polyisocyanurate.
 - g. Polyolefin.
 - h. Polystyrene.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - Lagging adhesives.
 - 6. Sealants.
 - 7. Factory-applied jackets.
 - 8. Field-applied fabric-reinforcing mesh.
 - 9. Field-applied cloths.
 - 10. Field-applied jackets.
 - 11. Tapes.
 - 12. Securements.
 - 13. Corner angles.
- B. Related Sections include the following:
 - 1. Division 21 Section "Fire-Suppression Systems Insulation."
 - 2. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

- 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
- 2. Detail attachment and covering of heat tracing inside insulation.
- 3. Detail insulation application at pipe expansion joints for each type of insulation.
- 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
- 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
- 6. Detail application of field-applied jackets.
- 7. Detail application at linkages of control devices.
- 8. Detail field application for each equipment type.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Sample Sizes:
 - Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
 - b. Sheet Form Insulation Materials: 12 inches (300 mm) square.
 - c. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).
 - d. Sheet Jacket Materials: 12 inches (300 mm) square.
 - e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- D. Qualification Data: For qualified Installer.
- E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- F. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. 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.
 - 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.

C. Deleted requirement for insulation mockups.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

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. Calcium Silicate:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Industrial Insulation Group (The); Thermo-12 Gold.
- 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- I. 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 I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 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.
- J. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; HTB 23 Spin-Glas.
 - b. Owens Corning; High Temperature Flexible Batt Insulations.
- K. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- L. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; FBX.
 - b. Johns Manville; 1000 Series Spin-Glas.
 - c. Owens Corning; High Temperature Industrial Board Insulations.
 - d. Rock Wool Manufacturing Company; Delta Board.
 - e. Roxul Inc.: Roxul RW.
 - f. Thermafiber; Thermafiber Industrial Felt.
- M. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 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 (454 deg C) 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.
- N. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

O. Phenolic:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - Kingspan Corp.; Koolphen K.
- 2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
- 3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
- 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- 5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
 - Board for Equipment Applications: ASJ.
- P. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Apache Products Company; ISO-25.
 - b. Dow Chemical Company (The); Trymer.
 - c. Duna USA Inc.; Corafoam.
 - d. Elliott Company; Elfoam.
 - 2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
 - 3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches (38 mm) as tested by ASTM E 84.

- 4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
- 5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Pipe Applications: ASJ.
 - b. Equipment Applications: ASJ.
- Q. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - Armacell LLC; Tubolit.
 - b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
 - c. RBX Corporation; Therma-cell.
- R. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F (0.038 W/m x K) after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Styrofoam.
 - b. Knauf Insulation; Knauf Polystyrene.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-97.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
 - c. Marathon Industries, Inc.; 290.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
 - 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. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
 - 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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aeroseal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact 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).
- E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 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).
- F. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F (29 to plus 60 deg C).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 97-13.
- G. ASJ Adhesive, and FSK and PVDC 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, available products that may be incorporated into the Work include, but are not limited to, 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).
- H. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow 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, available products that may be incorporated into the Work include, but are not limited to, 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 (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-30.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-35.
 - c. ITW TACC, Division of Illinois Tool Works; CB-25.
 - d. Marathon Industries, Inc.; 501.
 - e. Mon-Eco Industries, Inc.; 55-10.
 - Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
 - 3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
 - 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Encacel.
 - b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
 - c. Marathon Industries, Inc.; 570.

- d. Mon-Eco Industries, Inc.; 55-70.
- Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
- 3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
- 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
- 5. Color: White.
- E. Breather Mastic: Water based: suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 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 (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - 1. For indoor applications, use lagging adhesives that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
 - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
 - 4. Service Temperature Range: Minus 50 to plus 180 deg F (Minus 46 to plus 82 deg C).
 - 5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

- 1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
- 2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
- 3. Materials shall be compatible with insulation materials, jackets, and substrates.
- 4. Permanently flexible, elastomeric sealant.
- 5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
- 6. Color: White or gray.
- 7. 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. FSK and Metal Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 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 (Minus 40 to plus 121 deg C).
 - 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).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 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 (Minus 40 to plus 121 deg C).
- 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).

2.7 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 - 4. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 5. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms (0.007 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Vimasco Corporation; Elastafab 894.
- B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. inch (2 strands by 2 strands/sq. mm) for covering equipment.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Chil-Glas No. 5.
- C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm), in a Leno weave, for equipment and pipe.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. 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, available products that may be incorporated into the Work include, but are not limited to, 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.

C. Metal Jacket:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
- 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elhows
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.

- d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
- e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.11 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, available products that may be incorporated into the Work include, but are not limited to, 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 (75 mm).
 - 3. Thickness: 11.5 mils (0.29 mm).
 - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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, available products that may be incorporated into the Work include, but are not limited to, 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 (75 mm).
 - 3. Thickness: 6.5 mils (0.16 mm).
 - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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, available products that may be incorporated into the Work include, but are not limited to, 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 (50 mm).
 - 3. Thickness: 6 mils (0.15 mm).
 - 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 - 2. Width: 2 inches (50 mm).
 - 3. Thickness: 3.7 mils (0.093 mm).
 - 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, [available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 - 2. Width: 3 inches (75 mm).
 - 3. Film Thickness: [4 mils (0.10 mm)] [6 mils ((0.15 mm))].
 - 4. Adhesive Thickness: 1.5 mils (0.04 mm).
 - 5. Elongation at Break: 145 percent.
 - 6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.12 SECUREMENTS

A. Bands:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
- 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316] 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.
- 3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with [wing or closed seal.
- 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

- 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
- 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.: CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
- 3. 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, available products that may be incorporated into the Work include, but are not limited to, 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 (0.76 mm) thick by 2 inches (50 mm) square.
- c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-(2.6-mm-) 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.
- 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
 - c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 5. Self-Sticking-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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-(2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
- 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, 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.
- 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-(0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.
 - 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. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products. Inc.

2.13 CORNER ANGLES

- A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

- Verify that systems and equipment to be insulated have been tested and are free of defects.
- 2. Verify that surfaces to be insulated are clean and dry.
- 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 (50 mm) 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 (100 mm) 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.

3.4 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 (50 mm) 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 (50 mm).
 - 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.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

- 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
- Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
- 3. Protect exposed corners with secured corner angles.
- 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. 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.
- 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
- 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
- 7. Stagger joints between insulation layers at least 3 inches (75 mm).
- 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
- 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
- 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
 - 1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 - 2. Seal longitudinal seams and end joints.
- C. Deleted requirement for Insulation Boxes on Pumps.
- D. This section shall not apply to factory insulated tanks and equipment.

3.6 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 (50 mm) 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.

3.7 CALCIUM SILICATE INSULATION INSTALLATION

- A. Insulation Installation on Domestic Water Boiler Breechings:
 - 1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation material.
 - 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
 - 3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.
- B. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
 - 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
 - 3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
- C. 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 cut sections of block insulation of same material and thickness as pipe insulation.
- 4. Finish flange insulation same as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

- 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
- 2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
- 3. Finish fittings insulation same as pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:

- 1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- 2. Install insulation to flanges as specified for flange insulation application.
- 3. Finish valve and specialty insulation same as pipe insulation.

3.8 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

- 1. Secure each layer of 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 services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
- 4. For insulation with factory-applied jackets on below ambient services, 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 cut sections of cellular-glass block insulation of same thickness as pipe insulation.
- 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), 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. Secure according to manufacturer's written instructions.
- 2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of cellular-glass insulation to valve body.
 - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.

3.9 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install 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.
 - Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 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 (150 mm) 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 (25 mm), 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.

3.11 PHENOLIC INSULATION INSTALLATION

A. General Installation Requirements:

- 1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
- 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

B. Insulation Installation on Straight Pipes and Tubes:

- 1. Secure each layer of 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 services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
- 4. For insulation with factory-applied jackets with vapor retarders on below ambient services, 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.

C. 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 cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

- 1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- 3. Install insulation to flanges as specified for flange insulation application.

3.12 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

- 1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
- 2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
- 3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
- 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

- C. Insulation Installation on Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of polyisocyanurate insulation to valve body.
 - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.

3.13 POLYOLEFIN INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install 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 cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of polyolefin pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
 - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.14 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

- 1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
- 2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
- 3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
- 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed section of polystyrene insulation to valve body.
 - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.

3.15 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

- C. Where PVC jackets are indicated, install with 1-inch (25-mm) 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.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
 - 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 - 2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 - 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 - 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 - 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.16 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.17 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 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 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.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.18 DOMESTIC WATER BOILER BREECHING INSULATION SCHEDULE

- A. Round, exposed breeching and connector insulation shall be one of the following:
 - 1. Calcium Silicate: 4 inches (100 mm) thick.
 - 2. High-Temperature Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
 - 3. High-Temperature Mineral-Fiber Board: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
- B. Round, concealed breeching and connector insulation shall be one of the following:
 - 1. Calcium Silicate: 4 inches (100 mm) thick.
 - 2. High-Temperature Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
 - 3. High-Temperature Mineral-Fiber Board: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
- C. Rectangular, exposed breeching and connector insulation shall be one of the following:
 - 1. Calcium Silicate: 4 inches (100 mm) thick.
 - 2. High-Temperature Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
 - 3. High-Temperature Mineral-Fiber Board: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
- D. Rectangular, concealed breeching and connector insulation shall be one of the following:

- 1. Calcium Silicate: 4 inches (100 mm) thick.
- 2. High-Temperature Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
- 3. High-Temperature Mineral-Fiber Board: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

3.19 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Heat-exchanger (water-to-water for domestic water heating service) insulation shall be[one of] the following:
 - 1. Calcium Silicate: 3 inches (75 mm) thick.
 - 2. Cellular Glass: 3 inches (75 mm) thick.
 - 3. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
 - 4. Mineral-Fiber Pipe and Tank: 2 inches (50 mm).
- D. Domestic water pump insulation shall be[one of] the following:
 - 1. Cellular Glass: 2 inches (50 mm) thick.
 - 2. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
 - 3. Phenolic: 1 inch (25 mm) thick.
 - 4. Polyisocyanurate: 1 inch (25 mm) thick.
- E. Domestic hot-water pump insulation shall be[one of] the following:
 - 1. Cellular Glass: 2 inches (50 mm) thick.
 - 2. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
 - 3. Phenolic: 1 inch (25 mm) thick.
 - 4. Polyisocyanurate: 1 inch (25 mm) thick.
- F. Domestic hot-water storage tank insulation shall be one of the following, of thickness to provide an R-value of 12.5:
 - 1. Cellular glass.
 - 2. Mineral-Fiber Board: 3-lb/cu. ft. (48-kg/cu. m) nominal density.
 - 3. Mineral-fiber pipe and tank.
 - 4. Phenolic.

3.20 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. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.21 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 (DN 25) and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - b. Flexible Elastomeric: 1 inch (25 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - d. Phenolic: 1 inch (25 mm) thick.
 - e. Polyisocyanurate: 1 inch (25 mm) thick.
 - f. Polyolefin: 1 inch (25 mm) thick.
 - 2. NPS 1-1/4 (DN 32) and Larger: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - b. Flexible Elastomeric: 1 inch (25 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - d. Phenolic: 1 inch (25 mm) thick.
 - e. Polyisocyanurate: 1 inch (25 mm) thick.
 - f. Polyolefin: 1 inch (25 mm) thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - b. Flexible Elastomeric: 1 inch (25 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - d. Phenolic: 1 inch (25 mm) thick.
 - e. Polyisocyanurate: 1 inch (25 mm) thick.
 - f. Polyolefin: 1 inch (25 mm) thick.
 - 2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - b. Flexible Elastomeric: 1 inch (25 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - d. Phenolic: 1 inch (25 mm) thick.
 - e. Polyisocyanurate: 1 inch (25 mm) thick.
 - f. Polyolefin: 1 inch (25 mm) thick.
- C. Stormwater and Overflow:
 - 1. All Pipe Sizes: Insulation shall be one of the following:

- a. Cellular Glass: 1-1/2 inches (38 mm) thick.
- b. Flexible Elastomeric: 1 inch (25 mm) thick.
- c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
- d. Phenolic: 1 inch (25 mm) thick.
- e. Polyisocyanurate: 1 inch (25 mm) thick.
- f. Polyolefin: 1 inch (25 mm) thick.
- D. Roof Drain and Overflow Drain Bodies:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - b. Flexible Elastomeric: 1 inch (25 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - d. Phenolic: 1 inch (25 mm) thick.
 - e. Polyisocyanurate: 1 inch (25 mm) thick.
 - f. Polyolefin: 1 inch (25 mm) thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch (19 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - c. Polyolefin: 3/4 inch (19 mm) thick.
- F. Sanitary Waste Piping Where Heat Tracing Is Installed:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches (50 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches (38 mm) thick.
 - c. Phenolic: 1-1/2 inches (38 mm) thick.
 - d. Polyisocyanurate: 1-1/2 inches (38 mm) thick.
- G. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - b. Flexible Elastomeric: 1 inch (25 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - d. Phenolic: 1 inch (25 mm) thick.
 - e. Polyisocyanurate: 1 inch (25 mm) thick.
 - f. Polyolefin: 1 inch (25 mm)] thick.
- H. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
 - 1. All Pipe Sizes: Insulation shall be one of the following:

- a. Cellular Glass: 1-1/2 inches (38 mm) thick.
- b. Flexible Elastomeric: 1 inch (25 mm) thick.
- c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
- d. Phenolic: 1 inch (25 mm thick.
- e. Polyisocyanurate: 1 inch (25 mm) thick.
- f. Polyolefin: 1 inch (25 mm) thick.

I. Hot Service Drains:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Calcium Silicate: 1-1/2 inches (38 mm) thick.
 - b. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch (25 mm) thick.

J. Hot Service Vents:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Calcium Silicate: 1-1/2 inches (38 mm) thick.
 - b. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch (25 mm) thick.

3.22 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches (50 mm) thick.
 - b. Flexible Elastomeric: 2 inches (50 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
 - d. Phenolic: 2 inches (50 mm) thick.
 - e. Polyisocyanurate: 2 inches (50 mm) thick.
 - f. Polyolefin: 2 inches (50 mm) thick.
 - g. Polystyrene: 2 inches (50 mm) thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches (50 mm) thick.
 - b. Flexible Elastomeric: 2 inches (50 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
 - d. Phenolic: 2 inches (50 mm) thick.
 - e. Polyisocyanurate: 2 inches (50 mm) thick.
 - f. Polyolefin: 2 inches (50 mm) thick.
 - g. Polystyrene: 2 inches (50 mm) thick.
- C. Sanitary Waste Piping Where Heat Tracing Is Installed:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches (50 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
 - c. Phenolic: 2 inches (50 mm) thick.
 - d. Polyisocyanurate: 2 inches (50 mm) thick.

D. Hot Service Drains:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Calcium Silicate: 1-1/2 inches (38 mm) thick.
 - b. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

E. Hot Service Vents:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Calcium Silicate: 1-1/2 inches (38 mm) thick.
 - b. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
- 2. Encasement for piping.
- 3. Specialty valves.
- 4. Flexible connectors.
- 5. Water meters furnished by utility company for installation by Contractor.
- 6. Water meters.
- 7. Escutcheons.
- 8. Sleeves and sleeve seals.
- 9. Wall penetration systems.

1.3 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Backflow preventers and vacuum breakers.
 - 6. Escutcheons.
 - 7. Sleeves and sleeve seals.
 - 8. Water penetration systems.
- B. Water Samples: Specified in "Cleaning" Article.
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. HVAC hydronic piping.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components.
- C. Comply with NSF 61 for potable domestic water piping and components.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

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 (ASTM B 88M, Type B) water tube, drawn temper.
 - 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: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 5. Copper Pressure-Seal-Joint Fittings:
 - 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) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - 6. Copper Push-on-Joint Fittings:

- 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) NVent LLC.
- b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
- 7. Copper-Tube Extruded-Tee Connections:
 - 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) T-DRILL Industries Inc.
 - b. Description: Tee formed in copper tube according to ASTM F 2014.
- 8. Grooved-Joint Copper-Tube Appurtenances:
 - 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) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - b. Copper Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B) water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - 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) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

c. NPS 3 and NPS 4 (DN 80 and DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
 - 2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - a. Gaskets: AWWA C111, rubber.
 - 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
 - a. Gaskets: AWWA C111, rubber.
- C. Plain-End, Ductile-Iron Pipe: AWWA C151.
 - 1. Grooved-Joint, Ductile-Iron-Pipe Appurtenances:
 - 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) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Star Pipe Products.
 - 4) Victaulic Company.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 - c. Grooved-End, Ductile-Iron-Pipe Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B, Standard Weight. Include ends matching joining method.

- 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
- 2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- 3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
- 4. Flanges: ASME B16.1, Class 125, cast iron.
- 5. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
 - 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) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Star Pipe Products.
 - 4) Victaulic Company.
 - b. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - c. Grooved-End-Pipe Couplings for Galvanized-Steel Piping: AWWA C606 for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

2.5 CPVC PIPING

- A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40 and Schedule 80.
 - 1. CPVC Socket Fittings: ASTM F 438 for Schedule 40 and ASTM F 439 for Schedule 80.
 - 2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
- B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.
- C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.6 PVC PIPE AND FITTINGS

- A. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.
 - 1. PVC Socket Fittings: ASTM D 2466 for Schedule 40 and ASTM D 2467 for Schedule 80.
 - 2. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

2.7 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) 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.
- E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
 - 1. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.8 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: Sheet or Tube.
- C. Material: LLDPE film of 0.008-inch (0.20-mm) minimum thickness or high-density, cross-laminated PE film of 0.004-inch (0.10-mm) minimum thickness.
- D. Color: Black.

2.9 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.
- C. CPVC Union Ball Valves:
 - 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. American Valve, Inc.

- b. Asahi/America, Inc.
- c. Colonial Engineering, Inc.
- d. Fischer, George Inc.
- e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
- f. IPEX Inc.
- g. NIBCO INC.
- h. Sloane, George Fischer, Inc.
- i. Spears Manufacturing Company.
- j. Thermoplastic Valves Inc.

2. Description:

- a. Standard: MSS SP-122.
- b. Pressure Rating: [125 psig (860 kPa) at 73 deg F (23 deg C).
- c. Body Material: CPVC.
- d. Body Design: Union type.
- e. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded.
- f. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, flanged.
- g. Ball: CPVC; full port.
- h. Seals: PTFE or EPDM-rubber O-rings.
- i. Handle: Tee shaped.

D. PVC Union Ball Valves:

- 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. American Valve, Inc.
 - b. Asahi/America, Inc.
 - c. Colonial Engineering, Inc.
 - d. Fischer, George Inc.
 - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - f. IPEX Inc.
 - g. Jomar International, LTD.
 - h. King Bros. Industries.
 - i. Legend Valve.
 - j. McDonald, A.Y. Mfg. Co.
 - k. NIBCO INC.
 - I. Sloane, George Fischer, Inc.
 - m. Spears Manufacturing Company.
 - n. Thermoplastic Valves Inc.

2. Description:

- Standard: MSS SP-122.
- b. Pressure Rating: 125 psig (860 kPa) at 73 deg F (23 deg C).
- c. Body Material: PVC.
- d. Body Design: Union type.
- e. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded.

- f. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, flanged.
- g. Ball: PVC; full port.
- h. Seals: PTFE or EPDM-rubber O-rings.
- i. Handle: Tee shaped.

E. CPVC Non-Union Ball Valves:

- 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. American Valve, Inc.
 - b. Asahi/America, Inc.
 - c. King Bros. Industries.
 - d. Legend Valve.
 - e. NIBCO INC.
 - f. Spears Manufacturing Company.
 - g. Thermoplastic Valves Inc.

2. Description:

- Standard: MSS SP-122.
- b. Pressure Rating: 125 psig (860 kPa) at 73 deg F (23 deg C).
- c. Body Material: CPVC.
- d. Body Design: Non-union type.
- e. End Connections: Socket or threaded.
- f. Ball: CPVC; full or reduced port.
- g. Seals: PTFE or EPDM-rubber O-rings.
- h. Handle: Tee shaped.

F. PVC Non-Union Ball Valves:

- 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. American Valve, Inc.
 - b. Asahi/America, Inc.
 - c. Colonial Engineering, Inc.
 - d. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - e. IPEX Inc.
 - f. Jomar International, LTD.
 - g. King Bros. Industries.
 - h. Legend Valve.
 - i. McDonald, A.Y. Mfg. Co.
 - j. NIBCO INC.
 - k. Sloane, George Fischer, Inc.
 - I. Spears Manufacturing Company.
 - m. Thermoplastic Valves Inc.
- 2. Description:

- Standard: MSS SP-122.
- b. Pressure Rating: 125 psig (860 kPa) at 73 deg F (23 deg C).
- c. Body Material: PVC.
- d. Body Design: Non-union type.
- e. End Connections: Socket or threaded.
- f. Ball: PVC; full or reduced port.
- g. Seals: PTFE or EPDM-rubber O-rings.
- h. Handle: Tee shaped.

G. CPVC Butterfly Valves:

- 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. Fischer, George Inc.
 - b. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - c. NIBCO INC.
 - d. Sloane, George Fischer, Inc.
 - e. Spears Manufacturing Company.
 - f. Thermoplastic Valves Inc.

2. Description:

- a. Pressure Rating: 125 psig (860 kPa) at 73 deg F (23 deg C).
- b. Body Material: CPVC.
- c. Body Design: Lug or wafer type.
- d. Seat: EPDM rubber.
- e. Seals: PTFE or EPDM-rubber O-rings.
- f. Disc: CPVC.
- g. Stem: Stainless steel.
- h. Handle: Lever.

H. PVC Butterfly Valves:

- 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. American Valve, Inc.
 - b. Asahi/America, Inc.
 - c. Colonial Engineering, Inc.
 - d. Fischer, George Inc.
 - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - f. IPEX Inc.
 - g. Legend Valve.
 - h. NIBCO INC.
 - i. Sloane, George Fischer, Inc.
 - j. Spears Manufacturing Company.
 - k. Thermoplastic Valves Inc.

2. Description:

- a. Pressure Rating: 125 psig (860 kPa) at 73 deg F (23 deg C).
- b. Body Material: PVC.
- c. Body Design: Lug or wafer type.
- d. Seat: EPDM rubber.
- e. Seals: PTFE or EPDM-rubber O-rings.
- f. Disc: PVC.
- g. Stem: Stainless steel.
- h. Handle: Lever.

I. CPVC Ball Check Valves:

- 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. American Valve, Inc.
 - b. Asahi/America, Inc.
 - c. Colonial Engineering, Inc.
 - d. Fischer, George Inc.
 - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - f. IPEX Inc.
 - g. NIBCO INC.
 - h. Sloane, George Fischer, Inc.
 - i. Spears Manufacturing Company.
 - j. Thermoplastic Valves Inc.

2. Description:

- a. Pressure Rating: [125 psig (860 kPa) at 73 deg F (23 deg C).
- b. Body Material: CPVC.
- c. Body Design: Union-type ball check.
- d. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded.
- e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, flanged.
- f. Ball: CPVC.
- g. Seals: EPDM- or FKM-rubber O-rings.

J. PVC Ball Check Valves:

- 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. American Valve, Inc.
 - b. Asahi/America, Inc.
 - c. Colonial Engineering, Inc.
 - d. Fischer, George Inc.
 - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - f. IPEX Inc.
 - g. Legend Valve.
 - h. NIBCO INC.
 - i. Sloane, George Fischer, Inc.

- j. Spears Manufacturing Company.
- k. Thermoplastic Valves Inc.

2. Description:

- a. Pressure Rating: 125 psig (860 kPa) at 73 deg F (23 deg C).
- b. Body Material: PVC.
- c. Body Design: Union-type ball check.
- d. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded.
- e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, flanged.
- f. Ball: PVC.
- g. Seals: EPDM- or FKM-rubber O-rings.

K. CPVC Gate Valves:

- 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. Sloane, George Fischer, Inc.
 - b. Spears Manufacturing Company.

2. Description:

- a. Pressure Rating: 125 psig (860 kPa) at 73 deg F (23 deg C).
- b. Body Material: CPVC.
- c. Body Design: Nonrising stem.
- d. End Connections for Valves NPS 2 (DN 50) and Smaller: Socket or Threaded.
- e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged.
- f. Gate and Stem: Plastic.
- g. Seals: EPDM rubber.
- h. Handle: Wheel.

L. PVC Gate Valves:

- 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. Asahi/America, Inc.
 - b. King Bros. Industries.
 - c. Sloane, George Fischer, Inc.
 - d. Spears Manufacturing Company.

2. Description:

- a. Pressure Rating: 125 psig (860 kPa) at 73 deg F (23 deg C).
- b. Body Material: PVC.
- c. Body Design: Nonrising stem.
- d. End Connections for Valves NPS 2 (DN 50) and Smaller: Socket or Threaded.

- e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged.
- f. Gate and Stem: Plastic.
- g. Seals: EPDM rubber.
- h. Handle: Wheel.

2.10 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 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. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc; a Sensus company.
 - g. Viking Johnson; c/o Mueller Co.
- D. Plastic-to-Metal Transition Fittings:
 - 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. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 - 2. Description: CPVC or 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.
- E. Plastic-to-Metal Transition Unions:
 - 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. Colonial Engineering, Inc.

- b. NIBCO INC.
- c. Spears Manufacturing Company.
- 2. Description: CPVC or PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

2.11 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. 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. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Hart Industries International, Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products.

2. Description:

- a. Pressure Rating: 50 psig (1035 kPa) at 180 deg F (82 deg C).
- b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

- 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. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Factory-fabricated, bolted, companion-flange assembly.
- b. Pressure Rating: 150 psig (1035 kPa).
- c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

- 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. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.

2. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig (1035 kPa).
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.

2. Description:

- Galvanized-steel coupling.
- b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
- c. End Connections: Female threaded.
- d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

- 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. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Company.

2. Description:

- a. Electroplated steel nipple complying with ASTM F 1545.
- b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
- c. End Connections: Male threaded or grooved.
- d. Lining: Inert and noncorrosive, propylene.

2.12 FLEXIBLE CONNECTORS

- 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. Flex-Hose Co., Inc.
 - 2. Flexicraft Industries.
 - 3. Flex Pression, Ltd.
 - 4. Flex-Weld, Inc.
 - 5. Hyspan Precision Products, Inc.
 - 6. Mercer Rubber Co.
 - 7. Metraflex, Inc.
 - 8. Proco Products, Inc.
 - 9. Tozen Corporation.
 - 10. Unaflex, Inc.
 - 11. Universal Metal Hose; a Hyspan company
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
 - 2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
 - 2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 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 ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- H. Install domestic water piping level and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. 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.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping adjacent to equipment and specialties to allow service and maintenance.
- N. Install piping to permit valve servicing.
- O. 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.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install PEX piping with loop at each change of direction of more than 90 degrees.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

- U. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- V. 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.

3.3 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. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- J. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.
- K. Steel-Piping Grooved Joints: Cut or roll groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

- L. 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.
- M. 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. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Piping: Join according to ASTM D 2855.
- N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 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 or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) 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.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65) and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.

- 2. NPS 2 (DN 50) and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water PipingNPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration Controls for Plumbing Piping and Equipment".
- B. 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 (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) If Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - 7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- F. Install supports for vertical copper tubing every 10 feet (3 m).
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - 7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - 8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- H. Install supports for vertical steel piping every 15 feet (4.5 m).
- Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod
 - 4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - 5. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - 6. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- J. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
- K. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.
- L. Install hangers for vertical PEX piping every 48 inches (1200 mm).

- M. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- N. Install supports for vertical PVC piping every 48 inches (1200 mm).
- O. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 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 exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. 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.
 - 4. 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 (DN 65) and larger.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.10 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe

and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 WALL PENETRATION SYSTEM INSTALLATION

- A. Install wall penetration systems in new, exterior concrete walls.
- B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.12 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.13 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 (345 kPa) 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.

3.14 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.15 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.
 - 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
 - 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 (50 mg/L) 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 (200 mg/L) 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. Clean non-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 procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.16 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building service piping, NPS 3 (DN 80) and smaller, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper solder-joint fittings; and brazed joints.
 - 2. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type L (ASTM B 88M, Type B)]; wrought-copper solder-joint fittings; and brazed joints.
 - 2. Mechanical-joint, ductile-iron pipe; standard-pattern mechanical-joint fittings; and mechanical joints.

- 3. Push-on-joint, ductile-iron pipe; standard-pattern push-on-joint fittings; and gasketed joints.
- 4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- 5. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- F. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper solder-joint fittings; and brazed joints.
 - 2. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- G. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
 - 1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper solder-joint fittings; and soldered joints.
 - 3. CPVC, Schedule 40 pipe; CPVC, Schedule 40 socket fittings; and solvent-cemented joints.
 - 4. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- H. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) wrought-copper solder-ioint fittings; and soldered ioints.
 - 2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 - 4. CPVC, Schedule 40 pipe; CPVC, Schedule 40 socket fittings; and solvent-cemented joints.
 - 5. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- I. Aboveground domestic water piping, NPS 5 to NPS 8 (DN 125 to DN 200), shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper solder-joint fittings; and soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B; grooved-joint copper-tube appurtenances; and grooved joints.
 - 3. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - 4. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 - 5. CPVC, Schedule 40 pipe; CPVC, Schedule 40 socket fittings; and solvent-cemented joints.
 - 6. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.

- J. Aboveground, combined domestic-water-service and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN300) shall be one of the following:
 - 1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
 - 2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

3.17 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.
- D. CPVC and PVC valves matching piping materials may be used.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated water mixing valves.
 - 6. Strainers.
 - 7. Outlet boxes.
 - 8. Hose stations.
 - 9. Hose bibbs.
 - 10. Wall hydrants.
 - 11. Ground hydrants.
 - 12. Post hydrants.
 - 13. Drain valves.
 - 14. Water hammer arresters.
 - 15. Air vents.
 - 16. Trap-seal primer valves.
 - 17. Trap-seal primer systems.

B. Related Sections include the following:

- 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
- 2. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.4 SUBMITTALS

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

- B. Shop Drawings: Diagram power, signal, and control wiring.
- Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. 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."

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. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Rough bronze.
- B. Hose-Connection Vacuum Breakers:
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.

- d. Legend Valve.
- e. MIFAB, Inc.
- f. Prier Products, Inc.
- g. Watts Industries, Inc.; Water Products Div.
- h. Woodford Manufacturing Company.
- i. Zurn Plumbing Products Group; Light Commercial Operation.
- j. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1011.
- 3. Body: Bronze, nonremovable, with manual drain.
- 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
- 5. Finish: Rough bronze.

C. Pressure Vacuum Breakers:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1020.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
- 5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
 - d. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1035.
- 3. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10) matching faucet size.
- 4. Body: Bronze.
- 5. End Connections: Threaded.
- 6. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.

- 2. Standard: ASSE 1056.
- 3. Operation: Continuous-pressure applications.
- Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1012.
 - Operation: Continuous-pressure applications.
 - 4. Body: Bronze.
 - 5. End Connections: Union, solderjoint.
 - 6. Finish: Rough bronze.
- B. Reduced-Pressure-Principle Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - Standard: ASSE 1013.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
 - 5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
 - 6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 - 7. Configuration: Designed for horizontal, straight through flow.
 - 8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

- C. Double-Check Backflow-Prevention Assemblies:
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1015.
 - 3. Operation: Continuous-pressure applications, unless otherwise indicated.
 - 4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
 - 5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
 - 6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 - 7. Configuration: Designed for horizontal, straight through flow.
 - 8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
- D. Dual-Check-Valve Backflow Preventers:
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Ford Meter Box Company, Inc. (The).
 - f. Honeywell Water Controls.
 - g. Legend Valve.
 - h. McDonald, A. Y. Mfg. Co.
 - i. Mueller Co.; Water Products Div.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Plumbing Products Group: Wilkins Div.
 - 2. Standard: ASSE 1024.
 - 3. Operation: Continuous-pressure applications.
 - 4. Body: Bronze with union inlet.
- E. Reduced-Pressure-Detector, Fire-Protection Backflow-Preventer Assemblies :
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.

- 2. Standard: ASSE 1047 and FMG approved or UL listed.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
- 5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
- 6. End Connections: Flanged.
- 7. Configuration: Designed for horizontal, straight through flow.
- Accessories:
 - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

F. Double-Check, Detector-Assembly Backflow Preventers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1048 and FMG approved or UL listed.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
- 5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
- 6. End Connections: Flanged.
- 7. Configuration: Designed for horizontal, straight through flow.
- 8. Accessories:
 - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

G. Hose-Connection Backflow Preventers:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
- 2. Standard: ASSE 1052.
- 3. Operation: Up to 10-foot head of water (30-kPa) back pressure.
- 4. Inlet Size: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
- 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
- 6. Capacity: At least 3-gpm (0.19-L/s) flow.

H. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.
- b. FEBCO; SPX Valves & Controls.
- c. Flomatic Corporation.
- d. Watts Industries, Inc.; Water Products Div.
- e. Zurn Plumbing Products Group; Wilkins Div.
- 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1003.
- 3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
- 4. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
- 5. Valves for Booster Heater Water Supply: Include integral bypass.
- 6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

B. Water Control Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CLA-VAL Automatic Control Valves.
 - b. Flomatic Corporation.
 - c. OCV Control Valves.
 - d. Watts Industries, Inc.; Ames Fluid Control Systems.
 - e. Watts Industries, Inc.; Watts ACV.
 - f. Zurn Plumbing Products Group; Wilkins Div.
- 2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
- 3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa) minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
- 4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a. Pattern: Angle-valve design.
 - b. Trim: Stainless steel.
- 5. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.

2.4 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
 - 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. TAC Americas.
 - f. Taco, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - 2. Type: Ball valve with two readout ports and memory setting indicator.
 - 3. Body: Brass or bronze,
 - 4. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
 - 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Cast-Iron Calibrated Balancing Valves:
 - 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. TAC Americas.
 - f. Watts Industries, Inc.; Water Products Div.
 - Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
 - 3. Size: Same as connected piping, but not smaller than NPS 2-1/2 (DN 65).
- C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- D. Memory-Stop Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries. Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
 - 2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 - 3. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
 - 4. Size: NPS 2 (DN 50) or smaller.
 - 5. Body: Copper alloy.

- 6. Port: Standard or full port.
- 7. Ball: Chrome-plated brass.
- 8. Seats and Seals: Replaceable.
- 9. End Connections: Solder joint or threaded.
- 10. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Water-Temperature Limiting Devices:
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Leonard Valve Company.
 - g. Powers; a Watts Industries Co.
 - h. Symmons Industries, Inc.
 - i. Taco, Inc.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig (860 kPa).
 - 4. Type: Thermostatically controlled water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Threaded union inlets and outlet.
 - 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 8. Valve Finish: Rough bronze.
- B. Primary, Thermostatic, Water Mixing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2.
- a. Armstrong International, Inc.
- b. Lawler Manufacturing Company, Inc.
- c. Leonard Valve Company.
- d. Powers; a Watts Industries Co.
- e. Symmons Industries, Inc.
- 3. Standard: ASSE 1017.
- Pressure Rating: 125 psig (860 kPa).
- 5. Type: Exposed-mounting, thermostatically controlled water mixing valve.
- 6. Material: Bronze body with corrosion-resistant interior components.
- 7. Connections: Threaded union inlets and outlet.
- 8. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
- 9. Valve Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
- 10. Valve Finish: Rough bronze.

- 11. Piping Finish Copper.
- 12. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.
- C. Manifold, Thermostatic, Water-Mixing-Valve Assemblies:
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leonard Valve Company.
 - b. Powers: a Watts Industries Co.
 - c. Symmons Industries, Inc.
 - 2. Description: Factory-fabricated, exposed-mounting, thermostatically controlled, water-mixing-valve assembly in two-valve parallel arrangement.
 - 3. Large-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
 - 4. Intermediate-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
 - 5. Small-Flow Parallel: Thermostatic water mixing valve.
 - 6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
 - 7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
 - 8. Component Pressure Ratings: 125 psig (860 kPa) minimum, unless otherwise indicated.
 - 9. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.
 - 10. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.
 - 11. Piping Finish: Copper.
- D. Individual-Fixture, Water Tempering Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company.
 - f. Powers; a Watts Industries Co.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
 - 3. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
 - 4. Body: Bronze body with corrosion-resistant interior components.
 - 5. Temperature Control: Adjustable.
 - 6. Inlets and Outlet: Threaded.
 - 7. Finish: Rough or chrome-plated bronze.
- E. Primary Water Tempering Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Heat-Timer Corporation.
 - b. Holby Valve Co., Inc.

- Standard: ASSE 1017, thermostatically controlled tempering valve, listed as tempering valve.
- 3. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
- 4. Body: Bronze.
- 5. Temperature Control: Manual.
- 6. Inlets and Outlet: Threaded.
- 7. Valve Finish: Rough bronze.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

- 1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
- 2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (DN 65) and larger.
- 3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
- 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
- 5. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.033 inch (0.84 mm).
 - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm).
 - c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch (2.54 mm).
- 6. Drain: Pipe plug.

2.7 HOSE STATIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ARCHON Industries, Inc.
 - 2. Armstrong International, Inc.
 - 3. Cooney Brothers, Inc.
 - 4. DynaFluid Ltd.
 - 5. Leonard Valve Company.
 - 6. Strahman Valves, Inc.
 - 7. T & S Brass and Bronze Works, Inc.

B. Single-Temperature-Water Hose Stations:

- 1. Standard: ASME A112.18.1.
- 2. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
- 3. Hose-Rack Material: Stainless steel.
- 4. Body Material: Bronze.
- 5. Body Finish: Rough bronze.
- 6. Nozzle: With hand squeeze on-off control.
- 7. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

2.8 HOSE BIBBS

A. Hose Bibbs :

- 1. Standard: ASME A112.18.1 for sediment faucets.
- 2. Body Material: Bronze.
- 3. Seat: Bronze, replaceable.
- Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
- 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
- 6. Pressure Rating: 125 psig (860 kPa).
- 7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
- 8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
- 9. Finish for Service Areas: Rough bronze.
- 10. Finish for Finished Rooms: Chrome or nickel plated.
- 11. Operation for Equipment Rooms: Wheel handle or operating key.
- 12. Operation for Service Areas: Wheel handle.
- 13. Operation for Finished Rooms: Wheel handle.
- 14. Include operating key with each operating-key hose bibb.
- 15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.

j.

- 2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
- 3. Pressure Rating: 125 psig (860 kPa).
- 4. Operation: Loose key.
- Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
- 6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
- 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 8. Box: Deep, flush mounting with cover.
- 9. Box and Cover Finish: Polished nickel bronze.
- Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
- 12. Operating Keys(s): Two with each wall hydrant.

2.10 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 (2760-kPa) minimum CWP.
- 3. Size: NPS 3/4 (DN 20).
- 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.

B. Gate-Valve-Type, Hose-End Drain Valves:

- 1. Standard: MSS SP-80 for gate valves.
- 2. Pressure Rating: Class 125.
- 3. Size: NPS 3/4 (DN 20).
- 4. Body: ASTM B 62 bronze.
- 5. Inlet: NPS 3/4 (DN 20) threaded or solder joint.
- 6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

- 1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
- 2. Pressure Rating: 200-psig (1380-kPa) minimum CWP or Class 125.
- 3. Size: NPS 3/4 (DN 20).
- 4. Body: Copper alloy or ASTM B 62 bronze.
- 5. Drain: NPS 1/8 (DN 6) side outlet with cap.

2.11 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASSE 1010 or PDI-WH 201.
- Type: Metal bellows.
- 4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.12 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

- 1. Body: Bronze.
- 2. Pressure Rating: 125-psig (860-kPa) minimum pressure rating at 140 deg F (60 deg C).
- 3. Float: Replaceable, corrosion-resistant metal.
- 4. Mechanism and Seat: Stainless steel.
- 5. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

- 1. Body: Stainless steel.
- 2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating.
- 3. Float: Replaceable, corrosion-resistant metal.
- 4. Mechanism and Seat: Stainless steel.
- 5. Inlet and Vent Outlet End Connections: Threaded.

2.13 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
- 2. Standard: ASSE 1018.
- 3. Pressure Rating: 125 psig (860 kPa) minimum.
- 4. Body: Bronze.
- 5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
- 6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
- 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- 2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
- 3. Size: NPS 1-1/4 (DN 32) minimum.
- 4. Material: Chrome-plated, cast brass.

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 backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. 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.
- G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- H. Install outlet boxes recessed in wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - 1. Install shutoff valve on outlet if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- J. Install water hammer arresters in water piping according to PDI-WH 201.
- K. Install air vents at high points of water piping.

- L. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- M. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- N. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check backflow-prevention assemblies.
 - 5. Carbonated-beverage-machine backflow preventers.
 - 6. Dual-check-valve backflow preventers.
 - 7. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
 - 8. Double-check, detector-assembly backflow preventers.
 - 9. Water pressure-reducing valves.
 - 10. Calibrated balancing valves.
 - 11. Primary, thermostatic, water mixing valves.
 - 12. Manifold, thermostatic, water-mixing-valve assemblies.
 - 13. Photographic-process, thermostatic, water-mixing-valve assemblies.
 - 14. Primary water tempering valves.
 - 15. Outlet boxes.
 - 16. Hose stations.
 - 17. Supply-type, trap-seal primer valves.
 - 18. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE, VENT, STORM AND A/C CONDENSATE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following for soil, waste, vent, storm and A/C condensate piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Sewerage Pumps."

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, Vent, Storm and A/C Condensate Piping: 10-foot head of water (30 kPa).
 - 2. Sanitary Sewer, Force-Main Piping: 100 psig (690 kPa).

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.6 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; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS
 - A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
 - B. Gaskets: ASTM C 564, rubber.
 - C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

- C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO.
 - 2) Fernco, Inc.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO.
 - 2) Clamp-All Corp.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
 - 3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) MG Piping Products Co.
- D. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - Manufacturers:
 - a. ANACO.
- 2.5 COPPER TUBE AND FITTINGS
 - A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- 2.6 PVC PIPE AND FITTINGS
 - A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

- 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
 - 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.
 - 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.
- D. Solvent Cement and Adhesive Primer:
 - 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
 - 4. Copper DWV tube, copper drainage fittings, and soldered joints.
 - 5. PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
 - 4. PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
 - 4. Copper DWV tube, copper drainage fittings, and soldered joints.

- 5. PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Aboveground, vent piping NPS 5 (DN 125) and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
 - 4. PVC pipe, PVC socket fittings, and solvent-cemented joints.
- F. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be any of the following:
 - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings and hubless-coupling joints.
 - 3. Cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
- G. Underground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:
 - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings and hubless-coupling joints.
 - 3. Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.
 - 4. Cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
- H. Aboveground sanitary-sewage force mains shall be any of the following:
 - 1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
 - 2. Steel pipe, pressure fittings, and threaded joints.

3.3 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- E. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- 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."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

- G. 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.
- H. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- J. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- L. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
- M. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- N. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

- D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- E. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- F. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
 - 2. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - Install backwater valves in accessible locations.
 - 4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.6 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. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) 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 (10-mm) minimum rods.

- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm)
 - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 - NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm)
 - 4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod. 2.
 - NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod. 3.
 - NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod. 6.
 - NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod. 7.
 - NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- H. Install supports for vertical steel piping every 15 feet (4.5 m).
- l. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2 (DN 50): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - NPS 3 (DN 80): 96 inches (2400 mm) with 1/2-inch (13-mm) rod. 2.
 - NPS 4 (DN 100): 108 inches (2700 mm) with 1/2-inch (13-mm) rod. 3.
 - NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
- J. Install supports for vertical stainless-steel piping every 10 feet (3 m).
- K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod. 5.
 - NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- Install supports for vertical copper tubing every 10 feet (3 m). L.
- M. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

- 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod
- 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
- 3. NPS 4 and 5 (DN 100 and 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
- 4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
- 5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- N. Install supports for vertical PVC piping every 48 inches (1200 mm).
- O. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. Connect force-main piping to the following:
 - 1. Sanitary Sewer: To exterior force main or sanitary manhole.
 - 2. Sewage Pumps: To sewage pump discharge.

3.8 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. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- 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 or, in absence of published procedures, as follows:

- 1. 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 separate report for each test, complete with diagram of portion of piping tested.
- 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
- 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
- 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 required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - Cap and subject piping to static-water pressure of 50 psig (345 kPa) 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.
 - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 4. Prepare reports for tests and required corrective action.

3.9 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.

3.10 PROTECTION

A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Floor drains.
 - 4. Trench drains.
 - 5. Channel drainage systems.
 - 6. Air-admittance valves.
 - 7. Roof flashing assemblies.
 - 8. Through-penetration firestop assemblies.
 - 9. Miscellaneous sanitary drainage piping specialties.
 - 10. Flashing materials.
 - 11. Grease interceptors.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. Grease interceptors.

- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.14.1.
 - 3. Size: Same as connected piping.
 - 4. Body: Cast iron.
 - 5. Cover: Cast iron with bolted access check valve.
 - 6. End Connections: Hub and spigot.

- 7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
- 8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Size: Same as floor drain outlet.
- 3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
- 4. Check Valve: Removable ball float.
- 5. Inlet: Threaded.
- 6. Outlet: Threaded or spigot.

C. Horizontal, Plastic Backwater Valves:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
 - f. Sioux Chief Manufacturing Company, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
- 2. Size: Same as connected piping.
- 3. Body: PVC.
- 4. Cover: Same material as body with threaded access to check valve.
- 5. Check Valve: Removable swing check.
- 6. End Connections: Socket type.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.

- 2. Standard: ASME A112.36.2M for cleanout test tee.
- 3. Size: Same as connected drainage piping
- 4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
- 5. Closure: Countersunk or raised-head, cast-iron plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- 7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M for cleanout.
- 3. Size: Same as connected branch.
- Type: Adjustable housing.
- 5. Body or Ferrule: Cast iron.
- 6. Clamping Device: Required.
- 7. Outlet Connection: Spigot.
- 8. Closure: Cast-iron plug.
- 9. Adjustable Housing Material: Cast iron with threads.
- 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
- 11. Frame and Cover Shape: Round.
- 12. Top Loading Classification: Heavy.
- 13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- 14. Standard: ASME A112.3.1.
- 15. Size: Same as connected branch.
- 16. Housing: Stainless steel.
- 17. Closure: Stainless steel with seal.
- 18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB. Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. 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: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
- 5. Closure: Countersunk or raised-head, drilled-and-threaded cast-iron plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- 7. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
- 8. Wall Access: Round, nickel-bronze wall-installation frame and cover.

D. Plastic Floor Cleanouts:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities; a division of Diverse Corporate Technologies.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
- 2. Size: Same as connected branch.
- 3. Body: PVC.
- 4. Closure Plug: PVC.
- 5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.6.3.
- 3. Body Material: Gray iron.
- 4. Top or Strainer Material: Bronze.
- 5. Top of Body and Strainer Finish: Nickel bronze.
- 6. Top Shape: Square.
- 7. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
- 8. Trap Material: Cast iron.
- 9. Trap Pattern Standard P-trap.

2.4 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-) thick, lead flashing collar and skirt extending at least 6 inches (150 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - 1. Open-Top Vent Cap: Without cap.
 - 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
 - 3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
 - 4. Size: Same as connected soil, waste, or vent stack.
 - 5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 - 7. Special Coating: Corrosion resistant on interior of fittings.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. 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.

B. 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 1 inch (25 mm) 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.

C. Stack Flashing Fittings:

- 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- 2. Size: Same as connected stack vent or vent stack.

D. Vent Caps:

- 1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
- 2. Size: Same as connected stack vent or vent stack.

E. Frost-Resistant Vent Terminals:

- 1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
- 2. Design: To provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

F. Expansion Joints:

- 1. Standard: ASME A112.21.2M.
- 2. Body: Cast iron with bronze sleeve, packing, and gland.
- 3. End Connections: Matching connected piping.
- 4. Size: Same as connected soil, waste, or vent piping.

2.7 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 - 2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 - 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
 - 2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm thickness).

- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.8 GREASE INTERCEPTORS

- A. Grease Interceptors:
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Rockford Sanitary Systems, Inc.
 - d. Schier Products Company.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.14.3 and PDI-G101, for intercepting and retaining fats, oils, and greases from food-preparation.
 - 3. Plumbing and Drainage Institute Seal: Required.
 - 4. Body Material: Cast iron or steel.
 - Interior Lining: Corrosion-resistant enamel.
 - 6. Exterior Coating: Corrosion-resistant enamel
 - 7. End Connections: Flanged.
 - 8. Cleanout: Integral.

2.9 MOTORS

- A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

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 backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. 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 (DN 100). Use NPS 4 (DN 100) 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 (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- I. Install through-penetration firestop assemblies in plastic stacks at floor penetrations.

- J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- L. Install vent caps on each vent pipe passing through roof.
- M. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- N. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 - 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 - 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- O. Install wood-blocking reinforcement for wall-mounting-type specialties.
- P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- Q. 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.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during remainder of construction period 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 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
 - 1. Faucets for lavatories, showers and sinks.
 - 2. Flushometers.
 - Toilet seats.
 - 4. Protective shielding guards.
 - 5. Fixture supports.
 - 6. Water closets.
 - 7. Waterless Urinals.
 - 8. Lavatories.
 - 9. Commercial sinks.
 - 10. Showers.
 - 11. Kitchen sinks.
 - 12. Service sinks.
 - 13. Service basins.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
 - 2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
 - 3. Division 22 Section "Drinking Fountains and Water Coolers."

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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.

1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period for Commercial Applications: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ALL PLUMBING FIXTURES

A. See Specifications and details on 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 floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to roughing-in drawings.
- I. 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.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- N. Install toilet seats on water closets.
- O. Install trap-seal liquid in dry urinals.
- P. 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.
- Q. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- R. 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.
- S. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- T. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.

- 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- U. 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.
- V. Install escutcheons at piping wall 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."
- W. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- X. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

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.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

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 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. 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.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- 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.

END OF SECTION 224000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Not all items in this section may be required for the completion of this Work. Where the associated materials and methods are required, the following requirements shall apply.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. HVAC demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.

1.3 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, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene-monomer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - Escutcheons.
- B. Welding certificates.

1.5 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 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 manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

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: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC, PVC, CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Thompson Plastics, Inc.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC, PVC, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Available Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.

DIELECTRIC FITTINGS

- D. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- E. Insulating Material: Suitable for system fluid, pressure, and temperature.

- F. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
 - 1. Available Manufacturers:
 - Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- G. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- H. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- J. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Available Manufacturers:
 - a. Perfection Corp.

- b. Precision Plumbing Products, Inc.
- c. Sioux Chief Manufacturing Co., Inc.
- d. Victaulic Co. of America.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM, NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic, Carbon steel or Stainless steel. Include two for each sealing element.
 - Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating, or 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 (0.6-mm) 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.

2.7 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] [Rough brass] [Polished chrome-plated and rough brass].
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - Finish: [Polished chrome-plated] [Rough brass] [Polished chrome-plated and rough brass].
- E. One-Piece, Stamped-Steel Type: With [set screw] [spring clips] [set screw or spring clips] and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With [concealed] [exposed-rivet] hinge, [set screw] [spring clips] [set screw or spring clips], and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 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 (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" 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 plug 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 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 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 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 according to the following:
 - 1. New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
- b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
- c. Insulated Piping: One-piece, stamped-steel type with spring clips.
- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
- f. Bare Piping at Ceiling Penetrations in Finished Spaces: [One-piece] [Split-casting] [One-piece or split-casting], cast-brass type with polished chrome-plated finish.
- g. Bare Piping at Ceiling Penetrations in Finished Spaces: [One-piece, stamped-steel type] [Split-plate, stamped-steel type with concealed hinge] [One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge] and set screw.
- h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with [polished chrome-plated] [rough-brass] finish.
- i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with [concealed] [exposed-rivet] [concealed or exposed-rivet] hinge and [set screw] [spring clips] [set screw or spring clips].
- j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
- k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with [set screw] [spring clips] [set screw or spring clips].
- I. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

- a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
- b. Insulated Piping: Split-plate, stamped-steel type with [concealed] [exposed-rivet] [concealed or exposed-rivet] hinge and spring clips.
- c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
- e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
- f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
- g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with [polished chrome-plated] [rough-brass] finish.
- h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with [concealed] [exposed-rivet] [concealed or exposed-rivet] hinge and set screw or spring clips.
- i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
- Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
- k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.

- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. [PVC] [Steel] Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsumboard partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 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.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 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.

- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. 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 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 leadfree 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. 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.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.

- 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 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) 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 not 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.

3.6 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use [3000-psi (20.7-MPa)] <Insert other>, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "[Cast-in-Place Concrete] [Miscellaneous Cast-in-Place Concrete]."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.9 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.

3.10 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 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 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.

1.3 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.
- C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) 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 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: [Class F] < Insert class>.
- J. Code Letter Designation:
 - 1. Motors [15] <Insert number> HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than [15] <Insert number> HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes [324T] <Insert number> 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. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

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 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- Equipment labels.
- 2. Warning signs and labels.
- 3. Pipe labels.
- Duct labels.
- 5. Stencils.
- 6. Valve tags.
- 7. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

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 (3.2 mm) thick, and having predrilled holes for attachment hardware.
- 2. Letter Color: Black
- 3. Background Color: White
- 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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 (A4) 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 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, [1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] < Insert dimension > thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black
- C. Background Color: Yellow
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws

- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS (Humidifier Condensate Piping)

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- 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 (38 mm) high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, [1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] < Insert dimension > thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White
- C. Background Color: Green
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.5 VALVE TAGS (Humidifier Condensate Piping)

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum
 - 2. Fasteners: Brass grommet and wire
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

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.

3.3 PIPE LABEL INSTALLATION (Humidifier Condensate Piping)

- 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 [50 feet (15 m)] <Insert dimension> along each run. Reduce intervals to [25 feet (7.6 m)] <Insert dimension> in areas of congested piping and equipment.
- 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 - Steam Condensate Piping:
 - a. Background Color: Yellow
 - b. Letter Color: Black

3.4 DUCT LABEL INSTALLATION

A. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Steam Condensate: 1-1/2 inches (38 mm) round
 - 2. Valve-Tag Color:
 - a. Steam Condensate: Natural
 - 3. Letter Color:
 - a. Steam Condensate: Black

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.

1.3 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.

1.4 SUBMITTALS

A. Qualification Data: Submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

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- B. Certified TAB reports.
- C. Sample report forms.
- D. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB or TABB.
- 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. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

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. 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.
- C. Examine the approved submittals for HVAC systems and equipment.

- D. 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.
- E. Examine ceiling plenums and underfloor air plenums (as applicable) used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 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.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. 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.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine system pumps to ensure absence of entrained air in the suction piping.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. 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.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.

- 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
- 6. Windows and doors can be closed so indicated conditions for system operations can be met

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 - 1. Comply with requirements in latest edition ASHRAE 62.1, "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 with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
 - 3. 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.

3.4 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. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. 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.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.

- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 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:
 - 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, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 5. 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.
 - 6. 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.
 - 7. 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.
 - 1. Measure airflow of submain and branch ducts.

- a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
- 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
- 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and 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.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. 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.

- Re-measure 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.

3.7 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.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.
- B. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

3.9 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 10 percent.
- 2. Air Outlets and Inlets: Plus or minus 10 percent.

3.10 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.11 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. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. 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 and pump 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. Settings for supply-air, static-pressure controller.
 - e. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outdoor, supply, return, and exhaust airflows.
 - 2. Duct, outlet, and inlet sizes.
 - 3. Terminal units.
 - 4. Balancing stations.
 - 5. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

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- 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).

- f. Cooling-coil static-pressure differential in inches wg (Pa).
- g. Outdoor airflow in cfm (L/s).
- h. Return airflow in cfm (L/s).
- i. Outdoor-air damper position.
- j. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch (mm) o.c.
- f. Make and model number.
- g. Face area in sq. ft. (sq. m).
- h. Tube size in NPS (DN).
- i. Tube and fin materials.
- j. Circuiting arrangement.
- 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressure drop in inches wg (Pa).
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
 - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - h. Refrigerant expansion valve and refrigerant types.
 - i. Refrigerant suction pressure in psig (kPa).
 - j. Refrigerant suction temperature in deg F (deg C).
- G. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h (kW).
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - I. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches (mm), and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

- 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Entering-air temperature in deg F (deg C).
 - c. Leaving-air temperature in deg F (deg C).
 - d. Air temperature differential in deg F (deg C).
 - e. Entering-air static pressure in inches wg (Pa).
 - f. Leaving-air static pressure in inches wg (Pa).
 - g. Air static-pressure differential in inches wg (Pa).
 - h. Low-fire fuel input in Btu/h (kW).
 - i. High-fire fuel input in Btu/h (kW).
 - j. Manifold pressure in psig (kPa).
 - k. High-temperature-limit setting in deg F (deg C).
 - I. Operating set point in Btu/h (kW).
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h (kW).
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm (L/s).
 - i. Face area in sq. ft. (sq. m).
 - j. Minimum face velocity in fpm (m/s).
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h (kW).
 - b. Air flow rate in cfm (L/s).
 - c. Air velocity in fpm (m/s).
 - d. Entering-air temperature in deg F (deg C).
 - e. Leaving-air temperature in deg F (deg C).
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

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- 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.

- f. Arrangement and class.
- g. Sheave make, size in inches (mm), and bore.
- h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches (mm), and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
- g. Number, make, and size of belts.
- 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F (deg C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in sq. ft. (sq. m).
 - g. Indicated air flow rate in cfm (L/s).
 - h. Indicated velocity in fpm (m/s).
 - i. Actual air flow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).
 - k. Barometric pressure in psig (Pa).
- K. Air-Terminal-Device Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.

- i. Effective area in sq. ft. (sq. m).
- 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Preliminary air flow rate as needed in cfm (L/s).
 - d. Preliminary velocity as needed in fpm (m/s).
 - e. Final air flow rate in cfm (L/s).
 - f. Final velocity in fpm (m/s).
 - g. Space temperature in deg F (deg C).
- L. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.12 INSPECTIONS

- A. Initial Inspection:
 - After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
 - 2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets (not including lab exhaust).
 - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Verify that balancing devices are marked with final balance position.
 - d. Note deviations from the Contract Documents in the final report.
- B. Final Inspection:
 - 1. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Engineer and College.
 - 2. Engineer and College shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 - 3. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 - 4. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
 - 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.13 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - Insulation Materials:
 - a. Mineral fiber blanket
 - b. Mineral fiber board
 - 2. Fire-rated insulation systems.
 - 3. Adhesives.
 - 4. Mastics
 - Sealants.
 - 6. Factory-applied jackets
 - 7. Field Applied Jackets.
 - 8. Tapes.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Qualification Data: For qualified Installer.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

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- D. 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, available products that may be incorporated into the Work include, but are not limited to, 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.
- E. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.

2.2 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, available products that may be incorporated into the Work include, but are not limited to, 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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements provide one of the following:
 - a. Aeroflex USA Inc.; Aeroseal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.

- d. RBX Corporation; Rubatex Contact 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).
- D. 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, available products that may be incorporated into the Work include, but are not limited to, 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).

2.3 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 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 (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 4. Solids Content: ASTM D 1644. 59 percent by volume and 71 percent by weight.
 - 5. Color: White.

2.4 SEALANTS

- A. Joint Sealants:
- B. FSK and Metal Jacket Flashing Sealants:

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- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 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 (Minus 40 to plus 121 deg C).
- 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).
- C. EPDM roofing membrane sealing system as specified by membrane manufacturer.

2.5 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Ethylene Propylene Diene Monomer Roofing Membrane EPDM
 - Non-reinforced uniform, flexible sheet made from Ethylene Propylene Diene Monomer, ASTM D 4637, Type I. Basis of Design: JM EPDM NR, JM EPDM Nonreinforced [or architect pre approved equal]
 - 2. Thickness (minimum): 45 mils (1.1 mm)
 - 3. Exposed Face Color: Black.
- C. AUXILIARY EPDM Materials Single Ply
 - 1. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 - 2. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- D. Sheet Flashing: Manufacturer's sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane. Primer Material: Manufacturer's standard synthetic-rubber polymer primer

- E. Seaming Material: Manufacturer's standard **3-inch- (75-mm)** wide minimum, butyl splice tape with release film.
- F. Bonding Adhesive: Manufacturer's standard **solvent**-based bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, sealants and other accessories.

2.7 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, available products that may be incorporated into the Work include, but are not limited to, 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 (75 mm).
 - 3. Thickness: 11.5 mils (0.29 mm).
 - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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, available products that may be incorporated into the Work include, but are not limited to, 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 (75 mm).
 - 3. Thickness: 6.5 mils (0.16 mm).
 - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 (50 mm) 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 (100 mm) 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.

3.4 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 (50 mm) below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. 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 (50 mm).
 - Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
 - 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 (50 mm).
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 MINERAL-FIBER INSULATION INSTALLATION

- A. 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation

- joints. Install additional pins to hold insulation tightly against surface at cross bracing.
- 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - Repair punctures, tears, and penetrations with tape or mastic to maintain vaporbarrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) 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 (75 mm).
- Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm)
- 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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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. 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - Repair punctures, tears, and penetrations with tape or mastic to maintain vaporbarrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) 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 (75 mm).
- 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect ductwork, randomly, 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 duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

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3.8 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply, return, and exhaust air (to isolation damper).
 - 2. Outdoor ductwork
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums and casings.
 - Flexible connectors.
 - 6. Vibration-control devices.
 - 7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air and exhaust air (to isolation damper) duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density R-5 installed.
- B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density R-5 installed.
- C. Concealed, rectangular, supply-air and exhaust air (to isolation damper) duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density R-5 installed.
- D. Concealed, rectangular, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.

3.10 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Exposed, rectangular, supply-air duct insulation shall bethe following:

- 1. Mineral-Fiber Board with EPDM Jacket: 2 inches (50 mm) thick and 2-lb/cu. ft. nominal density.
- C. Exposed, rectangular, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board with EPDM Jacket: 2 inches (50 mm) thick and 2-lb/cu. ft. nominal density.

END OF SECTION 230700

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS

1.1 GENERAL

- A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Facility Management and Control System (FMCS), utilizing Direct Digital Controls as shown on the drawings and as described herein.
- B. Drawings are diagrammatic only.
- C. The new installed system shall Schneider Electric I/A Series, web accessible, interoperable Facilities Management and Control System (FMCS) based on server/thin client architecture. The FMCS System shall seamlessly integrate all points of control, monitoring, alarming and logging which will be accessible using the new laptop and workstation located in the building.
- D. The new server and Schneider Electric I/A Series software (Point names, Graphics, Schedules, Commands Configuration in the GUI Server Application/WEB Browser client's software) shall provided as required to facilitate the expansion of this facility and future integraion to a campus wide network. It shall be the responsibility of the FMCS bidder to provide all necessary license files, programming, commissioning and graphics.
- E. Field level DDC shall be Lonworks compliant and communicate with the supervisory controllers via the Lon protocol.
- F. The new Schneider Electric I/A Series FMCS alarm notification via email, text messaging, and paging shall be integrated to this building's FMCS network.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUMMARY

A. This Section includes the Building Management System (BMS) control equipment for HVAC systems and components, including open protocol control components for terminal heating and cooling units.

1.4 DEFINITIONS

- A. ARP: Address Resolution Protocol
- B. ASC: Application Specific Controller.
- C. BMS: Building Management System
- D. CAC: Custom Application Controller.
- E. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
- F. DDC: Direct Digital Control

G. DDE: Dynamic Data Exchange

H. FTT: Free Topology Transceivers

I. GUI: Graphical User Interface

J. HVAC: Heating, Ventilation, and Air Conditioning

K. LAN: Local Area Network

L. MER: Mechanical Equipment Room

M. ODBC: Open DataBase Connectivity

N. PID: Proportional, Integral, Derivative

O. PES: Portable Engineering Station

P. POT: Portable Operator's Terminal

Q. SNVT: Standard Network Variables Types

R. SQL: Structured Query Language

S. UDP: User Datagram Protocol

T. UNC: Universal Network Controller

U. VAV: Variable Air Volume Box

1.5 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 colorgraphic displays available on at least 64 client computers, and electronic interfaces and actuation devices, as shown on the drawings and as described herein.
- B. The Local Area Network (LAN) shall be either a 10 or 100 Mpbs 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.
- C. 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.
- D. The system will consist of an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol, as the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135-1995, BACnet functionality to assure interoperability between all system components. Both the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-1995, BACnet protocol is required to assure that the project is fully supported by the two leading HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs.

- E. Where necessary or desired, LonTalk[™] packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth.
 - 1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide-lines for such encapsulation and shall be based on industry standard protocols.
 - 2. The products used in constructing the BMS shall be LonMark™ compliant.
 - 3. In those instances in which Lon-Mark™ devices are not available, the BMS contractor shall provide LonWorks™ devices with application source code, device resource files, and external interface definitions.
- F. The software tools required to network manage both the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-1995, BACnet protocol must be provided with the system. Drawings are dia-grammatic 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.
- G. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.
 - 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 Invensys Factory office. Invensys Factory office 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. Supervision, calibration and checkout of the system shall be by the employees of Invensys Factory office. Supplier shall have an in place support facility within 50 miles of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.
- 1.6 INSTALLATION OF PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION.
 - A. Hydronic Piping:
 - 1. Control Valves.
 - 2. Flow Switches.

- 3. Temperature Sensor Wells and Sockets.
- 4. Flowmeters.

B. Ductwork Accessories:

- 1. Automatic Dampers.
- 2. Airflow Stations.
- 3. Terminal Unit Controls.

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, 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. Schedule of dampers including size, leakage, and flow characteristics.
 - 6. Schedule of valves including close-off and flow characteristics.
 - 7. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 - 8. Listing of connected data points, including connected control unit and input device.
 - 9. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 - 10. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
- C. External Interface Files: XIF files or object diagrams for each DDC system component (Custom Application Controller and Application Specific Controller) proposed.
- D. ANSI / ASHRAE™ Standard 135-1995, BACnet PIC Statement: Proof of Compliance Level 3 or higher is required to protect building owner by reducing future maintenance and expansion costs.
- E. Samples: For each color required, of each type of thermostat cover.
- F. 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.

- G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- H. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. Include the following:.
 - 1. Maintenance instructions and lists of spare parts for each type of control device and compressed air station.
 - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 - 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 5. Calibration records and list of set points.
- I. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- J. 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 QUALITY ASSURANCE.

- A. The system manufacturer shall meet design requirements as shown on the drawings and as described herein with no exceptions.
- B. The system manufacturer shall, as a minimum, manufacture and supply the Custom Application Controller, Application Specific 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 direct employment of the temperature control system manufacturer.
- D. The Building Management System contractor shall have a full service facility within 50 miles of the project that is staffed with engineers trained in Integrating Interoperable Systems and technicians fully capable of providing LonWorks instructions and routine emergency maintenance service on all system components.
- E. Mechanical equipment manufacturers desiring to provide DDC type controls as factory mounted equipment, shall provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BMS contractor.
- F. 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.
- G. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems.".
- H. Comply with National Electric Code, UL-916 Energy Management Systems, LonMark™, ULC, FCC Part 15, subpart J, Class B Computing Devices.
- I. Comply with EIA Standard 709.1 LonTalk[™] protocol for DDC system control components.

1.9 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.

1.10 COORDINATION.

- A. Coordinate location of thermostats, humidistats, 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 location of concrete bases. Cast anchor-bolt inserts int.o bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete".
- E. Coordinate with the Owner's IT department on locations for UNC's, ethernet communication cabling and TCP/IP addresses.

1.11 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 hours standard working hours.

1.12 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 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Electric, Electronic, and DDC Systems:
 - a. The basis of design is Schneider Electric I/A Series
 - b. Honeywell Enterprise Building Integrator
 - c. Trane Tracer

2.2 DDC EQUIPMENT

- A. Workstation Server Hardware Station: IBM-compatible microcomputer with minimum configuration as follows:
 - 1. Processor: 2-Intel Pentium 4, 3.00 GHz., or faster.
 - 2. Random-Access Memory: 2GB ECC SDRAM., minimum.
 - 3. Graphics: Super video graphic adapter (SVGA), minimum 1024 x 768 pixels, 2.0-MB EDO video memory.
 - 4. Monitor: Flat panel 19 inches (17.4 viewable, minimum), noninterlaced, color, with maximum 0.28-mm dot pitch.
 - 5. Keyboard: QWERTY, 105 keys in ergonomic shape.
 - 6. Hard-Disk Drive: 150GB 10K RPM Ultra 160 SCSI Hard Drive, minimum.
 - 7. Embedded Intel PRO/100+ Server Adapter for TCP/IP Communication
 - 8. DVD-RW Drive: 24X, IDE DVD-RW with software decoding.
 - 9. Mouse: Two button.
 - 10. Operating System: Microsoft Windows XP Pro.
- B. Provide Color Printer, ink-jet type. The printer shall have:
 - 1. Print Head: 1440 x 1440 dpi photoquality color resolution.
 - 2. Internal Memory Buffer: 32KB.
 - 3. Paper Handling: Minimum of 100 sheets.
 - 4. Print Speed: Minimum of 8 ppm in black and 4 ppm in color.
- C. UPS (uninterruptable power supply) shall be installed at the server Size for 50% spare capacity with sufficient capacity to allow emergency power for a minimum of 10 minutes backup.
- D. GUI Server Application Software: Include the following:

Input/output capability from operator station for monitoring, graphical depiction and controlling all of the points listed in the input/output point list. The operator shall be able to monitor and access all points by means of clear concise English names without having to understand or reference hardware point locations or controller programs.

- 1. Operating System: The GUI shall run on Microsoft Windows NT Workstation 4.0, Service Pack 4, Windows 2000, or later.
- 2. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

- 3. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
 - a. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
 - b. Overall building floor plans shall be provided with up to date room names, equipment tags and locations. Equipment tags shall act as "hot-links" to individual equipment graphical data access screens.
 - c. Equipment graphical data access screens shall be provided based on the control schematics within the contract documents with all points, devices, data etc indicated. All assocated set points shall be adjustable through this screen.
 - d. Global inputs and out puts shall have a dedicated screen providing all pertinent information and set point adjustments.
 - e. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
 - f. Graphics shall support layering and each graphic object shall be configurable for assignment to one a layer. A minimum of six layers shall be supported.
 - g. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
 - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
- 4. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
- 5. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.
- 6. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
 - a. Create, delete or modify control strategies.
 - b. Add/delete objects to the system.
 - c. Tune control loops through the adjustment of control loop parameters.
 - d. Enable or disable control strategies.
 - e. Generate hard copy records or control strategies on a printer.
 - f. Select points to be alarmable and define the alarm state.
 - g. Select points to be trended over a period of time and initiate the recording of values automatically.
- 7. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- 8. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict

the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

- 9. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- 10. Alarm Console
 - a. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
 - b. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

E. Web Browser Clients

- 1. The system shall be capable of supporting <u>unlimited</u> clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine are <u>not acceptable.</u>
- 2. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS are **not acceptable**.
- 3. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- 4. The Web browser client shall support at a minimum, the following functions:
 - a. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
 - b. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
 - c. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
 - d. Storage of the graphical screens shall be in the Building Control Units (BC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
 - e. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
 - f. User's shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - 1) Modify common application objects, such as schedules, calendars, and set points in a graphical manner.

- a) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
- b) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
- Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
- 3) View logs and charts
- 4) View and acknowledge alarms
- g. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
- h. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

F. Portable Engineering Stations

- 1. Provide a Portable Engineering Station (PES) color display personal computer, software, and interfaces to provide; uploading/downloading of Custom Application Controller and Application Specific Controllers databases, monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs, monitoring and overrides of all controller physical input/output points, and editing of controller resident time schedules. PES connectivity shall be via digital wall sensor connected to controller.
- 2. The Portable Engineering Station shall use Visio and all programming shall be graphical.
- 3. The Portable Engineering Station shall be able to access any other controller on that segment of the LAN
- 4. Connection of a PES to the Custom Application Controller or Application Specific Controller shall not interfere with normal network operation in any way, prevent alarms from being transmitted or centrally initiated commands from being executed.
- 5. If the PES cannot be used for both the CAC's and ASC's, provide, in addition to the PES, the separate color display personnal computer(s), software, and interfaces required to provide full PES functionality for both the CAC's and ASC's.
- 6. Hardware for the PES shall consist of the following:
 - a. Pentium III processor
 - b. Large 15" UXGA active matrix (TFT) display
 - c. 256 MB 133 MHz SDRAM memory
 - d. 60 GB internal hard drive
 - e. Ethernert 10/1000
 - f. Integrated 56 Kbps modem
 - g. PCMCIA LON Card
- 7. Functionality of the PES connected to any CAC or ASC shall include:
 - a. Uploads and downloads of CAC and ASC Controller databases.
 - b. Uploads and downloads of CAC and ASC LonMark™ SNVT nci values.
 - c. Editing of LonMark™ SNVT nci values for minor equipment operational parameters (including minimum on/off and delay times, changeover values, minimum position setpoints, etc.). All such mechanical equipment editable nci values shall contain internal CAC and ASC Controller safety range limits to prevent accidental entry of out of range or invalid values.

- d. Monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs and test overrides of nvi SNVTs.
- e. Monitoring and overrides of all controller physical input/output points including timed overrides that automatically revert back to their normal value.
- f. Display of digital sensor values including diagnostics and calibration.
- g. Editing of controller time/date.
- h. Editing and overrides of resident Controller time schedules.
- i. LonMark™ information including program ID, Neuron ID, domain, subnet, and node.

G. Portable Operator's Terminal

- 1. Provide a Portable Operator's Terminal (POT) to provide; uploading/downloading of Custom Application Controller and Application Specific Controllers databases, monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs, monitoring and overrides of all controller physical input/output points, and editing of controller resident time schedules. POT connectivity shall be via digital wall sensor connected to controller.
- 2. Connection of a POT to the Custom Application Controller or Application Specific Controller shall not interfere with normal network operation in any way, prevent alarms from being transmitted or centrally initiated commands from being executed.
- 3. If the POT cannot be used for both the CAC's and ASC's, provide, in addition to the POT, the separate color display personnal computer(s), software, and interfaces required to provide full POT functionality for both the CAC's and ASC's.
- 4. Functionality of the POT connected to any CAC or ASC shall include:
 - a. Uploads and downloads of CAC and ASC Controller databases.
 - b. Uploads and downloads of CAC and ASC LonMark™ SNVT nci values.
 - c. Editing of LonMark™ SNVT nci values for minor equipment operational parameters (including minimum on/off and delay times, changeover values, minimum position setpoints, etc.). All such mechanical equipment editable nci values shall contain internal CAC and ASC Controller safety range limits to prevent accidental entry of out of range or invalid values.
 - d. Monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs and test overrides of nvi SNVTs.
 - e. Monitoring and overrides of all controller physical input/output points including timed overrides that automatically revert back to their normal value.
 - f. Display of digital sensor values including diagnostics and calibration.
 - g. Editing of controller time/date.
 - h. Editing and overrides of resident Controller time schedules.
 - i. LonMark™ information including program ID, Neuron ID, domain, subnet, and node.

H. Control Units General:

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.

1. 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.
- 2. 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.
- 3. Memory: The Control Units shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- 4. 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.
- 5. 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.
- 6. Automatic staggered restart of field equipment after restoration of power and short cycle protection.
- I. 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
 - f. Integration of LonWorks controller data and BACnet controller data
 - g. Network Management functions for all LonWorks based devices
 - 2. The Universal Network Controller UNC-501 must provide the following hardware features as a minimum:
 - a. One Ethernet Port 10/100 Mbps
 - b. One RS-232 port
 - c. One RS-232/RS485 port selectable
 - 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. 8 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)
 - j. 64 Mb Ram or greater
 - 3. The Universal Network Controller UNC 502 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. 8 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)
- j. 64 Mb Ram or greater
- 4. The Universal Network Controller UNC 600 must provide the following hardware features as a minimum:
 - a. One Ethernet Port 10/100 Mbps
 - b. Two RS-232 ports
 - c. One LonWorks Interface Port 78KB FTT-10A with Weidmuller connector
 - d. Power supply 120 VAC
 - e. Battery Backup
 - f. Real-time clock
 - g. Processor 550 MHz or greater
 - h. Minimum 3 GB IDE hard drive
 - i. 128 Mb Ram or greater
 - j. Operating system Windows NT 4.0 Embedded with Microsoft Java VM
- 5. 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.
- 6. The UNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 64 simultaneous users.
- 7. 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
- i. Pagers via paging services that initiate a page on receipt of email message
- j. Graphic with flashing alarm object(s)
- k. 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.
- m. Alarm actions may be initiated by user defined programmable objects created for that purpose.
- n. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- o. 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.
- p. Provide a "query" feature to allow review of specific alarms by user defined parameters.
- q. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
- r. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

8. 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.

- 9. 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.
- All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
- 11. 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
- 12. Systems that do not provide log data in HTML and XML formats at a minimum shall provide as an alternative Microsoft SQL Serverâ, Oracle 8i or Expressâ, Hyperion Solutions™ SQL Server.
- 13. The UNC shall have the ability to archive it's 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

14. 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 it's 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
 - User ID
 - 3) Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

15. DATABASE BACKUP AND STORAGE

- 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.

J. Custom Application Control Units:

Modular, comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control applications. CAC's shall be provided for Roof Top Units, Boiler Plant, Chiller Plant and other applications as shown on drawings and shall have published Lon-Works™ application source code, device resource files and external interface definitions

- 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.
- 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Peer to peer primary network level communications supporting at least 200 LonMark™ Standard Network Variables (SNVTs) per CAC utilizing at least 100 different SNVT types as documented by the LonMark™ Interoperability Association to assure present and future compatibility with third party LonMark™ devices. The 200 LonMark™ SNVTs, minimum, must be configurable in any combination all inputs or all outputs or any combination of input/outputs in any combination of the 100 different, minimum, SNVT types. The XIF SNVT order shall be definable, rather than random, to provide logical and effective LonMark™ network management. With the submittal package, contractor shall provide CAC performance data that specifies the exact maximum number of SNVTs available in any combination and a list of all available SNVT types including the LonMark™ Interoperability Association SNVT number.
 - b. Automatic communications loss detection to maintain normal control functionality regardless of available network 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 LonMark™ tools from providing improper and unrealistic inputs to CAC 's.
- 3. Local operator interface port provides for download from and connection to portable workstation.
- 4. Communication: The Custom Application Controller shall communicate via the Primary Controller Network between BMS Controllers and other LonWorks™ devices. CAC's shall communicate with the Building Controller and ASC's at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 709.1).

K. Application Specific Control Units:

Single board construction comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control and unitary applications. ASCs 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 ASCs firmware shall support all mandatory and all optional LonMark™ Standard Network Variables (SNVTs) for their LonMark™ profile as documented by the LonMark™ Interoperability Association. Bidder shall provide proof of ASC compliance for all the mandatory and all optional LonMark™ SNVTs. ASCs shall be based on the Echelon Neuron 3150 microprocessor working with the ASCs stand alone control program.

- 1. Units monitor or control each input/output point; process information; and download from the operator station.
- 2. 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 LonMark™ profiles for specific unitary applications.
- e. Support for all mandatory and optional LonMark[™] Standard Network Variable Types (SNVTs) for their LonMark[™] profile as documented by the LonMark[™] Interoperability Association
- f. Internal customizable safeties and limits to prevent third party LonMark[™] tools from providing improper and unrealistic inputs to ASC's.
- 3. Local operator interface port located on ASC and ASC sensor provides for download from or upload to portable workstation. All Lon bus devices shall be accessible from either port.
- 4. Communication: ASC's shall communicate with the Building Controller and CAC's at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 709.1).
- 5. ASC 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.
- 6. All ASC 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.

L. ASC Room Sensor

- 1. The ASC Sensor shall provide room temperature value and humidity to the ASC.
- 2. The ASC Sensor shall connect directly to the ASC and shall not utilize any of the I/O points of the controller.
- 3. The ASC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive.
- 4. There shall be one ASC Sensor per floor wired so that the communication jack will provide for a connection to the LON communication trunk to which the ASC controller is connected.
- 5. By connecting to this ASC Sensor, the connected controller, and all other devices on the LON bus shall be accessible by the Portable Engineering Station.
- 6. The ASC 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 ASC Sensor shall allow for the customization of the color on the esthetic covering as a standard offering.
- 8. The ASC Sensor shall be supplied in the following manner:
 - a. LCD display for viewing up to four possible displays, each showing a current value in the ASC or on the network.
 - b. Tenant override to allow timed override of unoccupied to occupied mode of operation.
 - c. LED indication of override state
 - d. Icons shall be utilized to represent sensor and controller function status, affording independence from a single language for use interface.
 - e. User interface with the ASC Sensor shall be provided as a configurable function, and shall offer password protection for access to network variable editing.
 - f. Six buttons to provide the following functions:
 - 1) Selection and adjustment of up to four setpoints (Setpoint Key)
 - 2) Selection of up to two HVAC modes (Mode Key)
 - 3) Selection of up to two fan modes (Fan Key)

- g. ASHRAE 95 compliance (LCD display and sub-base functionality)
- h. The room sensor shall provide access to additional diagnostic data from a sensoruser 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
- M. ASC VAV Controller Functionality.

Controls shall be microprocessor based Pressure Independent Variable Air Volume Digital Controllers, as shown in the drawings. The VAV ASC shall be a single integrated package consist-ing of a microprocessor, power supply, damper actuator, differential pressure transducer, field terminations, and application software. An alternate model shall be offered that allows for direct connectivity to an external actuator for those applications that employ a non-butterfly style damper configuration. All input/output signals shall be directly hardwired to the VAV ASC 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 re-sume 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.

- LonMark[™] VAV profiles for including support for all mandatory and optional LonMark[™]
 Standard Network Variable Types (SNVTs) as documented by the LonMark[™]
 Interoperability Association
- 2. The VAV ASC control algorithms shall be designed to limit the frequency of damper repositioning, to assure a minimum 10-year life from all components. The VAV ASC shall provide internal differential pressure transducer for pressure independent applications with an accuracy of ± 5 %. Flow through transducers requiring filter maintenance are not acceptable. The VAV ASC 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 VAV ASC.
- 3. All input/output signals shall be directly hardwired to the VAV ASC. A minimum of one input point of the VAV ASC shall employ a universal configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current sourced inputs. If a universal point is not available, a minimum of one input point (each) of the dry contact, resistive and analog voltage/current types must be provided on every controller. The outputs of the ASC shall be of the relay and universal analog form. All digital outputs shall be relay type. ASC 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.
- 4. The FMCS contractor shall provide VAV ASC to the VAV box manufacturer, for factory mounting. The VAV terminal unit supplier shall include in its price all costs for mounting of VAV ASC controller, connection of actuator to damper shaft, wiring of device power, wiring of VAV ASC to fan (fan powered terminal) and wiring to electric reheat coils or reheat valve actuator as specified on drawing.

- 5. The VAV terminal manufacturer shall provide a multi-point, averaging, differential pressure sensor mounted on the inlet to each VAV box. The VAV terminal unit manufacturer shall supply a line to low voltage transformer, of sufficient capacity, to power the VAV ASC plus all reheat valves and/or contactors and fan circuits associated with the VAV terminal and actuator assemblies. The FMCS contractor shall provide all reheat control valves to the mechanical contractor for mounting and piping. The FMCS contractor shall provide and install all wiring between the valve and VAV ASC controller and between the room sensor and the VAV ASC controller.
- 6. A minimum of two input points of the VAV ASC shall employ a universal configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current sourced inputs. If these universal points are not available, a minimum of two input point (each) of the dry contact, resistive and analog voltage/current types must be provided on every controller.

N. VAV Box Room Sensor

- The VAV Box Room Sensor shall provide room temperature value and humidity 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. There shall be one VAV Box Room Sensor per floor wired so that the communication jack will provide for a connection to the LON communication trunk to which the VAV controller is connected.
- 5. By connecting to this 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 viewing up to four possible displays, each showing a current value in the VAV Box or on the network.
 - b. Tenant override to allow timed override of unoccupied to occupied mode of operation.
 - c. LED indication of override state
 - d. Icons shall be utilized to represent sensor and controller function status, affording independence from a single language for use interface.
 - e. User interface with the VAV Box Room Sensor shall be provided as a configurable function, and shall offer password protection for access to network variable editing.
 - f. Six buttons to provide the following functions:
 - 1) Selection and adjustment of up to four setpoints (Setpoint Key)
 - 2) Selection of up to two HVAC modes (Mode Key)
 - 3) Selection of up to two fan modes (Fan Key)
 - g. ASHRAE 95 compliance (LCD display and sub-base functionality)
 - h. 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

O. ASC VAV –Air Balancing.

Through the Portable Engineering Station, the VAV ASC shall support a fully prompted Air Balance sequence. The Portable Engineering Station shall, when connected through the wall sensor, access the connected VAV ASC unit. The air balance sequence shall step the balancing contractor through the checkout and calibration of the VAV ASC. Upon completion of the balancing sequence, the flow values presented by the VAV ASC 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 use if the controller were to require 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.

P. ASC – Fan Coil Unit, Unit Ventilator, Heat Pump, or Packaged Rooftop Controller Functionality.

Controls shall be microprocessor based as shown in the drawings or indicated in the sequence of operations. The ASC shall be a single in-tegrated package consisting of a microprocessor, power supply, field terminations, and application software. The units shall be started and stopped from the BMS. A low limit protection thermostat in the mixed air section of the unit shall close down the outdoor air damper, open coil valves, and alarm the BMS when a temperature below 38°F (adjustable) is sensed. All input/output signals shall be directly hardwired to the ASC controller. In all cases, the controller shall automatically resume proper operation following the return of power to, or control by the ASC.

- 1. All ASCs must have an operating temperature range -40°F to 140°F and 5 to 95% RH, non condensing. because they are located in the proximity of extreme temperatures (hot water/steam pipes or the outdoor air).
- 2. All ASCs shall have capability for both ASHRAE Cycle II and ASHRAE Cycle III fully tested and validated. Bidder shall provide application documentation for ASC ASHRAE cycle II and III compliance including sequence of operation, controller program, and available SNVT's. The control program shall also be fully customizable in the field to accommodate any local or project specific requirements that may be required.
- 3. All duct averaging sensors for ASCs must be true continuous averaging units that sense the mean temperature over the complete length of the sensor end to end. Sensors that provide four or nine sensing points, which may be accurate due to air temperature stratifications, are not acceptable.
- 4. All ASCs shall be easily replaceable for ease of future maintenance and to minimize downtime.
- 5. The outputs of the ASC shall be of the relay Form C and universal analog form. All digital outputs shall be relay type Form C. ASC 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.

Q. LANs:

Capacity for a minimum of 64 client workstations connected to multiuser, multitasking environment with concurrent capability to access DDC network or control units.

1. 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
- 2. Primary Controller Network LAN
 - a. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K.
- 3. Secondary Network LAN (If Required)
 - a. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K
- 4. Remote Connection
 - a. ISDN, ADSL, T1 or dial-up connection, monthly charges paid by building owner

R. Software:

- 1. 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 enthalpy/economizer switchover.
 - Chiller Control Programs: Chilled water plant optimization with condenser water reset, chilled-water reset, chiller and pump equipment selection and sequencing.
 - 4) Boiler Control Programs: Boiler plant optimization with hot water supply reset, boiler and 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. Controller and Network Setup Software
 - 1) Network managements tools for LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-1995, BACnet protocol shall be provided including a network learn function, LonMark bindings, service pins, winks, and diagnostics.

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
 - 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.
 - g. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
 - 2. Humidity Sensors: Bulk polymer sensor element.
 - a. Accuracy: 2 percent at 10-90% RH with linear output.
 - b. Room Sensors: Range of 0 to 100 percent relative humidity
 - c. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
 - 3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: +/- 1 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA, 0-5 vDC, 0-10 vDC.
 - c. Building Static-Pressure Range: -.1 to .1, -0.25 to 0.25, -.5 to .5, -1.0 to 1.0 IN WC., jumper selectable.
 - d. Duct Static-Pressure Range: 0 to 1, 0 to 2.5, 0 to 5, 0 to 10 IN WC., jumper adjustable
 - 4. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.
- B. Equipment operation sensors as follows:

- 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 pump with adjustable pressure-differential range of 8 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.
- C. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- D. 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 vaporproof type.
- E. Carbon-Monoxide Detectors: Single or multichannel, dual-level detectors, using solid-state sensors with 3-year minimum life, maximum 15-minute sensor replacement, suitable over a temperature range of 23°F to 130°F, calibrated for 50 and 100 ppm, with maximum 120-second response time to 100-ppm carbon monoxide.
- F. 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.
- G. Oxygen Sensor and Transmitter: Single detectors, using solid-state zircon cell sensing, suitable over a temperature range of -32°F to 1100°F, calibrated for 0 to 5 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.
- H. Refrigerant Detectors: Dual-level detectors, using solid-state sensors, with alarm preset for 300 ppm, alarm indicator light, alarm silence light and button, alarm test light and button, and trouble light. Provide auxiliary relay preset for 150 ppm.
- I. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment, for flush mounting.

2.5 THERMOSTATS

- A. Combination Thermostat and Fan Switches: Line-voltage thermostat with two-, three-, or four-position, push-button or lever-operated fan switch.
 - 1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on two-gang switch box.
- B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.
- C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
 - 1. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.
 - 2. Dead Band: Maximum 2°F.
- D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.

- 1. Bulbs in water lines with separate wells of same material as bulb.
- 2. Bulbs in air ducts with flanges and shields.
- 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.
- 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
- 5. On-Off Thermostat: With precision snap switches, with electrical ratings required by application.
- 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- E. Fire-Protection Thermostats: UL listed with fixed or adjustable settings to operate at not less than 75°F above normal maximum operating temperature, with the following:
 - 1. Reset: Manual with control circuit arranged to directly shutdown appropriate equipment and provide remote annunciation at the GUI
- F. Room Thermostat Cover Construction:
 - 1. Set-Point Adjustment: Concealed or exposed
 - 2. Set-Point Indication: Concealed or exposed
 - 3. Thermometer: Optional
 - 4. Color: Neutral
 - 5. Orientation: Vertical or horizontal
- G. Room thermostat accessories include the following:
 - 1. Insulating Bases: For thermostats located on exterior walls.
 - 2. Thermostat Guards: As specified in tamper prone areas
 - 3. Adjusting Key: As required for calibration and cover screws.
 - 4. Set-Point Adjustment: 1/2-inch diameter, adjustment knob.
- H. 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.
- I. 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.
- J. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig., and cast housing with position indicator and adjusting knob.
- 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 waranty
 - 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.

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, 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 281°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. Globe Valves NPS 2-1/2" and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
- D. Hydronic system globe valves shall have the following characteristics:
 - 1. Rating: Class 125 for service at 125 psig. and 250°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.
- E. Steam system globe valves shall have the following characteristics:
 - 1. Rating: Class 125 for service at 125 psig. and 250°F operating conditions.
 - 2. Internal Construction: Replaceable plugs and seats of stainless steel.
 - 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:
 - a. 10 psig. inlet pressure and 5 psig. pressure drop.
 - b. Pressure drop across steam valve at a maximum flow of 80 percent of inlet pressure for low-pressure systems and 42 percent for high-pressure systems.
 - 4. Flow Characteristics: Modified linear characteristics.

- F. Butterfly Valves: 200 psig. maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
 - 1. Body Style: Wafer, Lug, or Groove
 - 2. Disc Type: Nickel-plated ductile iron, Aluminum bronze, Elastomer-coated ductile iron, Epoxy-coated ductile iron.
 - 3. Sizing: 1 psig. maximum pressure drop at design flow rate.
- G. Terminal Unit Control Valves: Bronze body, bronze trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.
 - 1. Rating: Class 125 for service at 125 psig. and 250°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 valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.8 DAMPERS

- A. Dampers: AMCA-rated, parallel, opposed blade designs; 0.1084 inch minimum, galvanized-steel frames with holes for duct mounting; damper blades shall not be less than 0.0635 inch galvanized steel with maximum blade width of .8 inches.
 - 1. Blades shall be secured to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: -40°F to 200°F
 - 3. For standard applications, include optional closed-cell neoprene edging.
 - 4. For low-leakage applications, use parallel- or opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4 inches wg. when the damper is being held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.9 CONTROL CABLE

- A. Electronic and Fiber-Optic Cable for Control Wiring: As specified in Division 27 Section "Control/Signal Transmission Media."
 - 1. EXECUTION

2.10 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that duct, pipe, and equipment mounted devices and wiring are installed before proceeding with installation.

2.11 INSTALLATION

- A. Install equipment level and plumb.
- B. Install software in control units and operator workstation. 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 thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 60 inches above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install guards or tamper proof enclosures on thermostats in the following locations:
 - 1. Entrances.
 - 2. Public areas.
 - Where indicated.
- F. Install automatic dampers according to Division 23 Section "Duct Accessories.
- G. Install damper actuators on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- H. Install labels and nameplates to identify control components according to Division 23 Section "Basic Mechanical Materials and Methods."
- I. Install labels and nameplates to identify control components according to Division 23 Section "Mechanical Identification."
- J. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- K. Install steam and condensate instrument wells, valves, and other accessories according to Division 15 Section "Steam and Condensate Piping."
- L. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
- M. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- N. Install electronic and fiber-optic cables according to Division 27 Section "Control/Signal Transmission Media."

2.12 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceways and Boxes."
- B. Install building wire and cable according to Division 26 Section "Conductors and Cables."
- C. Install signal and communication cable according to Division 27 Section "Control/Signal Transmission Media."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.

- 2. Install exposed cable in raceway.
- 3. Install concealed cable in raceway.
- 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
- 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
- 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

2.13 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

2.14 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Leak Test: After installation, fill system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
 - 4. Pressure test control for air piping:
 - a. Pressure test control air piping at 30 psig. or 1.5 times the operating pressure for 24 hours, with maximum 5 psig. loss.
 - b. Pressure test high-pressure control air piping at 150 psig. and low-pressure control air piping at 30 psig. for 2 hours, with maximum 1 psig
 - 5. Calibration and test
bothpneumatic and electric/electronic thermostats by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Replace damaged or malfunctioning controls and equipment.
 - 1. Start, test, and adjust control systems.

- 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
- 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

C. Verify DDC as follows:

- 1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
- 2. Verify operation of operator workstation.
- 3. Verify local control units including self-diagnostics.

2.15 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 8 hours' dedicated instructor time on-site.
 - 3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
 - Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 - 5. Schedule training with Owner, through Architect, with at least seven days' advance notice.

2.16 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by 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.

2.17 TRAINING

- A. Provide a minimum of 8 hours of on-site or classroom training throughout the contract period for personnel designated by the Owner. Each session shall be a minimum of four hours in length and must be coordinated with the building Owner. Train the designated staff of Owners Representative and Owner to enable them to:
 - 1. Proficiently operate the system
 - 2. Understand control system architecture and configuration
 - 3. Understand DDC system components
 - 4. Understand system operation, including DDC system control and optimizing routines (algorithms)
 - 5. Operate the workstation and peripherals
 - 6. Log on and off the system
 - 7. Access graphics, point reports, and logs
 - 8. Adjust and change system set points, time schedules, and holiday schedules

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- 9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
- 10. Understand system drawings, and Operation and Maintenance manual
- 11. Understand the job layout and location of control components
- 12. Access data from DDC controllers
- 13. Operate portable operators terminals

END OF SECTION 230900

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Single-wall rectangular ducts and fittings.
- 2. Single-wall round ducts and fittings.
- 3. Double-wall round ducts and fittings.
- Sheet metal materials.
- 5. Duct liner.
- 6. Sealants and gaskets.
- 7. 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.

1.3 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. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - Seismic-restraint devices.

B. Shop Drawings:

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- 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
- 2. Factory- and shop-fabricated ducts and fittings.
- 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
- 4. Elevation of top of ducts.
- 5. Dimensions of main duct runs from building grid lines.
- 6. Fittings.
- 7. Reinforcement and spacing.
- 8. Seam and joint construction.
- 9. Penetrations through fire-rated and other partitions.
- 10. Equipment installation based on equipment being used on Project.
- 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
- 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- D. Welding certificates.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and System Start-Up."

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D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL 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 SINGLE-WALL ROUND 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, provide products by one of the following] [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.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. 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."

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- 1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
- D. 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 (2286 mm) in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.
- E. 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 DOUBLE-WALL ROUND DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Lindab Inc.
 - 2. McGill AirFlow LLC.
 - 3. SEMCO Incorporated.
 - Sheet Metal Connectors, Inc.
- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - 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, ductsupport intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
 - 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."
 - a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

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- 3. 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."
- C. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch-(2.4-mm-) diameter perforations, with overall open area of 23 percent.
- D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.

2.4 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: G90 (Z275).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. 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.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.5 DUCT LINER

A. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II. Grade 1; and with NFPA 90A or NFPA 90B.

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- 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. Aeroflex USA Inc.
 - b. Armacell LLC.
 - c. Rubatex International, LLC
- 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. 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).

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- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
- 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) 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 buttededge 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 (12.7 m/s).
 - 7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) 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 (12.7 m/s) or where indicated.

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- 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 (2.4-mm) 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.

2.6 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. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 3 inches (76 mm).
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. 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).
- C. 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 (2500 Pa), 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.
- D. Solvent-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Base: Synthetic rubber resin.
 - 3. Solvent: Toluene and heptane.
 - 4. Solids Content: Minimum 60 percent.
 - 5. Shore A Hardness: Minimum 60.

- 6. Water resistant.
- 7. Mold and mildew resistant.
- 8. 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).
- 9. VOC: Maximum 395 g/L.
- 10. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
- 11. Service: Indoor or outdoor.
- 12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. 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).
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) 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.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electro-galvanized, 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 (Table 4-1M), "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:

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- 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.

2.8 SEISMIC-RESTRAINT DEVICES

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 ducts in maximum practical lengths.
- 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 (25 mm), 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 (38 mm).
- 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."

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3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 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, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): 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 (500 Pa) and Lower: Seal Class C.
 - Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
 - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 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.

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- 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
- 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) 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 (Table 4-1M), "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 (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. 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 (5 m).
- F. 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.

3.5 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.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
- B. Supply Ducts:
 - 1. Ducts Connected to Constant and Variable-Air-Volume Air-Handling Rooftop Units:
 - a. Pressure Class: Positive 3-inch wg (750 Pa).
 - b. Minimum SMACNA Seal Class: A.

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- c. SMACNA Leakage Class for Rectangular: 3.
- d. SMACNA Leakage Class for Round and Flat Oval: 3.
- e. All exposed supply ductwork shall be internally lined (rectangular) or double walled (round) for condensation control.

C. Return Ducts:

- 1. Ducts Connected to Constant and Variable Volume Air-Handling Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.

D. Exhaust Ducts:

- 1. Ducts Connected to Fans Exhausting Air:
 - a. Pressure Class: Negative 2-inch wg (500 Pa).
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel

F. Liner:

- 1. Supply Air Ducts (1st 20' from Rooftop Units): Flexible elastomeric, Type II, 1 inches thick.
- 2. Supply Air Ducts (non-insulated exposed in conditioned on non-conditioned space): Flexible elastomeric, Type II, 1 inches thick.
- 3. Return Air Ducts (1st 20' from Rooftop Units): Flexible elastomeric, Type II 1 inches 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 (5 m/s) 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 (5 to 7.6 m/s):
 - 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.
 - 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 (7.6 m/s) or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

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- 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
- 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) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

H. Branch Configuration:

- 1. 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: Spin in.
- 2. Round and Flat Oval: 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 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

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SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Backdraft and pressure relief dampers.
- 2. Manual volume dampers.
- 3. Fire dampers.
- 4. Smoke dampers.
- 5. Combination fire and smoke dampers.
- 6. Flange connectors.
- 7. Duct silencers.
- 8. Turning vanes.
- 9. Duct-mounted access panel assemblies.
- 10. Flexible connectors.
- 11. Flexible ducts.
- 12. Duct accessory hardware.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. LEED Submittal:

- 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 "Systems and Equipment."
- C. 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, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
- e. Duct security bars.
- f. Wiring Diagrams: For power, signal, and control wiring.
- D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- E. Source quality-control reports.
- F. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to [10] < Insert number> percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180)
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- 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. Duro Dyne Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Pottorff; a division of PCI Industries, Inc.
 - 5. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm (10 m/s)
- D. Maximum System Pressure: 1-inch wg (0.25 kPa)
- E. Frame: 0.052-inch- (1.3-mm-) thick, galvanized sheet steel with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - Material: Nonferrous metal.
 Diameter: 0.20 inch (5 mm)
- J. Tie Bars and Brackets: [Aluminum] [Galvanized steel].
- K. Return Spring: Adjustable tension.
- L. Bearings: [Steel ball] [Synthetic pivot bushings] [Steel ball or synthetic pivot bushings].
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20-gage (1.0-mm) minimum.
 - b. Sleeve Length: 6 inches (152 mm) minimum.
 - 6. Screen Mounting: Rear mounted.
 - 7. Screen Material: Aluminum.
 - 8. Screen Type: Insect.
 - 9. 90-degree stops.
- N. Suitable for horizontal or vertical mounting.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

- 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. McGill AirFlow LLC.
 - b. METALAIRE, Inc.
 - c. Nailor Industries Inc.
 - d. Pottorff; a division of PCI Industries, Inc.
 - e. Ruskin Company.
- Standard leakage rating.
- 3. Suitable for horizontal or vertical applications.
- Frames:
 - a. Hat-shaped, galvanized steel channels, 0.064-inch (1.62-mm) minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

- Multiple or single blade.
- b. Parallel- or opposed-blade design.
- c. Stiffen damper blades for stability.
- d. [Galvanized] [Stainless]-steel, 0.064 inch (1.62 mm) thick.
- 6. Blade Axles: Galvanized steel
- 7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

- 1. Size: 1-inch (25-mm) diameter.
- 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
- 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

- 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zincplated steel, and a 3/4-inch (19-mm) hexagon locking nut.
- 2. Include center hole to suit damper operating-rod size.
- 3. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arrow United Industries; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. McGill AirFlow LLC.
 - 4. METALAIRE, Inc.
 - 5. Nailor Industries Inc.
 - 6. Pottorff; a division of PCI Industries, Inc.
 - 7. Prefco; Perfect Air Control, Inc.
 - 8. Ruskin Company.
- B. Type: Dynamic rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream]; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.
- K. Heat-Responsive Device: [Electric] [Pneumatic] resettable link and switch package, factory installed, [165 deg F (74 deg C)] [and] [212 deg F (100 deg C)] <Insert temperature> rated.

2.5 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements.
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Ruskin Company.

- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame: Fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- F. Leakage: Class I
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application[with factory-furnished silicone calking].
- I. Damper Motors: Modulating or two-position action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC." Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
 - 5. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
 - 6. Electrical Connection: 115 V, single phase, 60 Hz

K. Accessories:

- 1. Auxiliary switches for signaling fan control or position indication.
- 2. Test and reset switches, remote mounted.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

- C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream]; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- F. Heat-Responsive Device: Replaceable, [165 deg F (74 deg C)] [212 deg F (100 deg C)] rated, fusible links.
- G. Smoke Detector: Integral, factory wired for single-point connection.
- H. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- I. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- J. Leakage: Class I Class II
- K. Rated pressure and velocity to exceed design airflow conditions.
- L. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application[with factory-furnished silicone calking].
- M. Master control panel for use in dynamic smoke-management systems.
- N. Damper Motors: Modulating or two-position action.
- O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC." Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.

P. Accessories:

- 1. Auxiliary switches for signaling fan control or position indication.
- 2. Test and reset switches, remote mounted.

2.7 FLANGE CONNECTORS

- 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. 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.

2.8 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements,
- B. Retain option in first paragraph below if manufacturer's name and model number are indicated in schedules or plans on Drawings; delete option and insert manufacturer's name and model number if not included on Drawings.
 - 1. Industrial Noise Control, Inc.
 - McGill AirFlow LLC.
 - 3. Ruskin Company.
 - 4. Vibro-Acoustics.

C. General Requirements:

- 1. Factory fabricated.
- 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
- 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

D. Shape:

- 1. Rectangular straight with splitters or baffles.
- 2. Round straight with center bodies or pods.
- 3. Rectangular elbow with splitters or baffles.
- 4. Round elbow with center bodies or pods.
- 5. Rectangular transitional with splitters or baffles.
- E. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90 (Z275) G60 (Z180), galvanized sheet steel, 0.034 inch.

- F. Inner Casing and Baffles: ASTM A 653/A 653M, [G90 (Z275)] [G60 (Z180)] galvanized sheet metal, 0.034 inch (0.85 mm) thick, and with 1/8-inch- (3-mm-) diameter perforations.
- G. Special Construction:
 - 1. Suitable for outdoor use.
 - 2. High transmission loss to achieve STC 45.
- H. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- I. Principal Sound-Absorbing Mechanism:
 - Controlled impedance membranes and broadly tuned resonators without absorptive media.
 - 2. Dissipative Film-lined type with fill material.
 - a. Fill Material: [Moisture-proof nonfibrous material].
 - b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
 - 3. Lining: Mylar Tedlar, or Fiberglas cloth.
- J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
 - 1. Flange connections.
 - 2. Reinforcement: Cross or trapeze angles for rigid suspension.
- K. Accessories:
 - 1. Integral 1-1/2 hour fire damper with access door. Access door to be high transmission loss to match silencer.
 - 2. Factory-installed end caps to prevent contamination during shipping.
 - 3. Removable splitters.
 - 4. Airflow measuring devices.
- L. Source Quality Control: Test according to ASTM E 477.
 - 1. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg (1500-Pa) static pressure, whichever is greater.
- M. Capacities and Characteristics(On Drawings):

2.9 TURNING VANES

- 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. 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. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. 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."
- E. Vane Construction: Double wall.
- F. Vane Construction: Single wall for ducts up to [48 inches (1200 mm)] <Insert dimension> wide and double wall for larger dimensions.

2.10 DUCT-MOUNTED ACCESS DOORS

- 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. Ductmate Industries, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. McGill AirFlow LLC.
 - 4. Nailor Industries Inc.
 - 5. 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:
 - 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 (25-by-25-mm) 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:
 - Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches[with outside and inside handles].
 - d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

2.11 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Flame Gard, Inc.
 - 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0428-inch (1.1-mm) stainless steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).
- F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.12 FLEXIBLE CONNECTORS

- 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. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 - 5.
- 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 [3-1/2 inches (89 mm)] [5-3/4 inches (146 mm)] wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) 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. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
 - 2. Minimum Tensile Strength: 500 lbf/inch (88 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd. (542 g/sq. m).
 - 2. Tensile Strength: 285 lbf/inch (50 N/mm) in the warp and 185 lbf/inch (32 N/mm) in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).
- H. 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 (6-mm) movement at start and stop.

2.13 FLEXIBLE DUCTS

- 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. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
 - 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 - 3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
 - 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

2.14 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct security bars. Construct duct security bars from 0.164-inch (4.18-mm) steel sleeve, continuously welded at all joints and 1/2-inch- (13-mm-) diameter steel bars, 6 inches (150 mm) o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch (63-by-63-by-6-mm) steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch (300-by-300-mm) hinged access panel with cam lock in duct in each side of sleeve.
- I. Connect ducts to duct silencers [with flexible duct connectors] [rigidly].
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream[and downstream] from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. 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.
 - 7. At each change in direction and at maximum 50-foot (15-m) spacing.
 - 8. Upstream[and downstream] from turning vanes.

- 9. Upstream or downstream from duct silencers.
- 10. Control devices requiring inspection.
- 11. Elsewhere as indicated.
- K. Install access doors with swing against duct static pressure.
- L. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 - 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 - 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 - 5. Body Access: 25 by 14 inches (635 by 355 mm).
 - 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- N. Install flexible connectors to connect ducts to equipment.
- O. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.
- Q. Connect flexible ducts to metal ducts with [adhesive] [liquid adhesive plus tape
- R. Install duct test holes where required for testing and balancing purposes.
- S. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Rectangular and square ceiling diffusers.
- Perforated diffusers.
- Linear slot diffusers.
- 4. Adjustable bar [registers] [grilles] [registers and grilles].
- Fixed face [registers] [grilles] [registers and grilles].

B. Related Sections:

- 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
- 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 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.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.

E. Source quality-control reports.

PART 2 - PRODUCTS

- A. Rectangular and Square Ceiling Diffusers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Hart & Cooley Inc.
 - c. Krueger.
 - d. METĀLAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Price Industries.
 - g. Titus.
 - h. Tuttle & Bailey.
 - 2. Devices shall be specifically designed for variable-air-volume flows.
 - 3. Material: Steel
 - 4. Finish: Baked enamel, white.
 - 5. Face Size: 24 by 24 inches.
 - 6. Face Style: Three cone.
 - 7. Mounting: See plans
 - 8. Pattern: Fixed.
 - 9. Dampers: Radial opposed blade

B. Perforated Diffuser

- Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Anemostat Products; a Mestek company.
 - b. Hart & Cooley Inc.
 - c. Krueger.
 - d. METALAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Price Industries.
 - g. Titus.
 - h. Tuttle & Bailey.
- 2. Material: Steel backpan and pattern controllers, with aluminum face.
- 3. Finish: Baked enamel, white
- 4. Face Size: 24 by 12 inches (600 by 300 mm
- 5. Duct Inlet: Round
- 6. Face Style: Flush.
- 7. Mounting: See Plans
- 8. Pattern Controller: None
- 9. Dampers: Radial opposed blade

C. Linear Slot Diffuser:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Anemostat Products; a Mestek company.
 - b. Hart & Cooley Inc.
 - c. Krueger.

- d. METALAIRE, Inc.
- e. Nailor Industries Inc.
- f. Price Industries.
- g. Titus.
- h. Tuttle & Bailey.
- 2. Devices shall be specifically designed for variable-air-volume flows.
- 3. Material Shell: [Steel] [Aluminum], [insulated] [noninsulated].
- 4. Material Pattern Controller and Tees: Aluminum.
- 5. Finish Face and Shell: [Baked enamel, black] < Insert finish >.
- 6. Finish Pattern Controller: [Baked enamel, black] < Insert finish >.
- 7. Finish Tees: [Baked enamel, white] [Baked enamel, color selected by Architect] <Insert finish>.
- 8. Slot Width: [1/2 inch (13 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)] [1-1/2 inches (38 mm)].

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Register:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Anemostat Products; a Mestek company.
 - b. Hart & Cooley Inc.
 - c. Krueger.
 - d. METALAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Price Industries.
 - g. Titus.
 - h. Tuttle & Bailey.
- 2. Material: Steel
- 3. Finish: Baked enamel, white.
- 4. Frame: 1-1/4 inches (32 mm).
- 5. Mounting: Countersunk screw
- 6. Damper Type: Adjustable opposed

B. Adjustable Bar Grille:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Hart & Cooley Inc.
 - c. Krueger.
 - d. METALAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Price Industries.
 - g. Titus.
 - h. Tuttle & Bailey.
- 2. Material: Steel
- 3. Finish: Baked enamel,.
- 4. Frame: 1-1/4 inches (32 mm)
- 5. Mounting: Countersunk screw.

C. Fixed Face Grille:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the
 - a. Anemostat Products; a Mestek company.
 - b. Hart & Cooley Inc.
 - c. Krueger.
 - d. Nailor Industries Inc.
 - e. Price Industries.
 - f. Titus.
 - g. Tuttle & Bailey.
- 2. Material: Steel
- 3. Finish: Baked enamel, white
- 4. Face Arrangement: 1/2-by-1/2-by-1/2-inch (13-by-13-by-13-mm) grid
- 5. Core Construction: Integral
- 6. Frame: 1-1/4 inches (32 mm) wide.
- 7. Mounting: Lay in

2.3 SOURCE QUALITY CONTROL

A. 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 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as 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 dampers.

3.3 **ADJUSTING**

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Electrical equipment coordination and installation.
- 2. Sleeves for raceways and cables.
- Sleeve seals.
- 4. Grout.
- Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
- J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve/

3.3 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
- B. Related Sections include the following:
 - Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW, USE and SO.
- D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC, Type SO and Type USE with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

2.4 SLEEVE SEALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, Inc.
 - Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- H. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- I. Class 2 Control Circuits: Power-limited cable, concealed in building finishes or Power-limited tray cable, in cable tray.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torquetightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed.

- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials.
- K. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. UTP cabling.
- 2. Low-voltage control cabling.
- 3. Control-circuit conductors.
- 4. Identification products.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- F. UTP: Unshielded twisted pair.
- G. RCDD: Registered Communications Distribution Designer.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTP and optical fiber 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.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.

B. Cable Trays:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cable Management Solutions, Inc.
 - b. Cablofil Inc.
 - c. Cooper B-Line, Inc.
 - d. Cope Tyco/Allied Tube & Conduit.
 - e. GS Metals Corp.
- 2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1.
 - a. Basket Cable Trays: 12 inches (300mm) wide and 3 inches (75 mm) deep. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
 - b. Ladder Cable Trays: 12" wide, and a rung spacing of 12 inches.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems.
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Description: Plywood, [fire-retardant treated,] 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry."

2.3 UTP CABLE

- 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. Belden CDT Inc.; Electronics Division.
 - 2. Berk-Tek; a Nexans company.
 - 3. CommScope, Inc.
 - 4. Draka USA.
 - 5. Genesis Cable Products; Honeywell International, Inc.
 - 6. KRONE Incorporated.
 - 7. Mohawk; a division of Belden CDT.
 - 8. Nordex/CDT; a subsidiary of Cable Design Technologies.
 - 9. Superior Essex Inc.
 - 10. SYSTIMAX Solutions; a CommScope, Inc. brand.
- B. Description: 100-ohm, four-pair UTP covered with a blue thermoplastic jacket.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 - 3. Comply with TIA/EIA-568-B.2, Category 6.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or Type CMG.
 - b. Communications, Riser Rated: Type CMR complying with UL 1666.
 - c. Communications, Limited Purpose: Type CMX.

2.4 UTP CABLE HARDWARE

- 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. American Technology Systems Industries, Inc.
 - 2. Dynacom Corporation.
 - 3. Hubbell Premise Wiring.
 - 4. KRONE Incorporated.
 - 5. Leviton Voice & Data Division.
 - 6. Molex Premise Networks; a division of Molex, Inc.
 - 7. Nordex/CDT; a subsidiary of Cable Design Technologies.
 - 8. Panduit Corp.
 - 9. Siemon Co. (The).
- B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

C. Connecting Blocks: 110 style for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare; integral with connector bodies, including plugs and jacks where indicated.

2.5 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.
 - 1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 - 1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with NFPA 262.
- C. Paired Cable: NFPA 70, Type CMG.
 - 1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC iacket.
 - 5. Flame Resistance: Comply with UL 1581.
- D. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 - 1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
 - 2. Fluorinated ethylene propylene insulation.
 - 3. Unshielded.
 - 4. Plastic jacket.
 - 5. Flame Resistance: NFPA 262, Flame Test.

2.6 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.
 - 1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - 2. Polypropylene insulation.
 - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 - PVC iacket
 - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire
 - 6. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.

- 2. Plastic insulation.
- 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
- 4. Plastic jacket.
- 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
- 6. Flame Resistance: Comply with NFPA 262.

2.7 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CM or Type CMG.
 - 1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - 2. PVC insulation.
 - Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - 2. Fluorinated ethylene propylene insulation.
 - 3. Unshielded.
 - 4. Fluorinated ethylene propylene jacket.
 - 5. Flame Resistance: NFPA 262, Flame Test.

2.8 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, power-limited cable, concealed in building finishes or power-limited tray cable, in cable tray, complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

2.9 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Brady Corporation.
 - 2. HellermannTvton.
 - 3. Kroy LLC.
 - 4. Panduit Corp.

- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows if possible.
- E. Pathway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed or in the corner of room if multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard if entering room from overhead.
 - 4. Extend conduits 3 inches (75 mm) above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:

- 1. Comply with TIA/EIA-568-B.1.
- 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
- 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
- 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- 5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
- 6. 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.
- 7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
- 8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

- 1. Comply with TIA/EIA-568-B.2.
- 2. Install 110-style IDC termination hardware unless otherwise indicated.
- 3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

E. Open-Cable Installation:

- 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
- 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
- 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Separation from EMI Sources:

- 1. Comply with BICSITDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
- 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (305 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
- 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

- Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
- b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
- c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (305 mm).
- 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
- 5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
- 6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No 14AWG.
 - 2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm, and signal circuits, No 12AWG.

3.4 FIRESTOPPING

- A. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP 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 after cross connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.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.
- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated:
 - Test wells.
 - Ground rods.
 - 3. Ground Conductors.
 - 4. Grounding Connectors.
- B. Field quality-control testing reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.

- 2. Stranded Conductors: ASTM B 8.
- 3. Tinned Conductors: ASTM B 33.
- 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
- 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
- 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches (6 by 50 mm) in cross section of length indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel 3/4 by 120 inches in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in telecom equipment rooms, and elsewhere as indicated.

- 1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- G. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells:

- 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

- 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
- 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
- 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

- Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
- 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart. Connect to building steel with appropriate size jumper conductor.
- H. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

- b. Perform tests by fall-of-potential method according to IEEE 81.
- 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment 10 ohms.
 - 2. Building Steel Ground Rods 10 ohms
 - 3. Substations and Pad-Mounted Equipment: 5 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Equipment supports.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. 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. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. GS Metals Corp.
 - d. Thomas & Betts Corporation.
 - e. Unistrut; Tyco International, Ltd.
 - 2. Metallic Coatings: Electro-galvanized according to MFMA-4.
 - 3. Painted Coatings: as applicable to manufacturer's standard painted coating applied according to MFMA-4.
 - 4. Channel Dimensions: Selected for applicable load criteria.
 - 5. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 6. Rated Strength: Selected to suit applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti Inc.

- 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
- 3) MKT Fastening, LLC.
- 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
- 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - Available Manufacturers: Subject to compliance with requirements, manufacturers
 offering products that may be incorporated into the Work include, but are not
 limited to, the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
- 6. Toggle Bolts: All-steel springhead type.
- 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - Secure raceways and cables to these supports with single-bolt conduit clamps or singlebolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - To New Concrete: Bolt to concrete inserts.
 - 2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 3. To Existing Concrete: Expansion anchor fasteners.
 - 4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

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

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Sections.
- C. Anchor equipment to concrete base.

- 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Qualification Data: For professional engineer and testing agency.
- C. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - Alflex Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. Manhattan/CDT/Cole-Flex.
 - 7. Maverick Tube Corporation.
 - 8. O-Z Gedney; a unit of General Signal.
 - 9. Wheatland Tube Company.
- B. IMC: ANSI C80.6.
- C. EMT: ANSI C80.3.
- D. FMC: Zinc-coated steel or aluminum.
- E. LFMC: Flexible steel conduit with PVC jacket.
- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Fittings for EMT: Steel or die-cast], set-screw or compression type.
- G. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Arnco Corporation.
 - 3. CertainTeed Corp.; Pipe & Plastics Group.
 - 4. Condux International, Inc.
 - 5. Lamson & Sessions; Carlon Electrical Products.

- 6. RACO; a Hubbell Company.
- 7. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: Type EPC-40-PVCLFNC: UL 1660.
- D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- E. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arnco Corporation.
 - 2. Endot Industries Inc.
 - 3. IPEX Inc.
 - Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible type, approved for riser or general-use installation.

2.4 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers.
 - 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. Thomas & Betts Corporation.

- b. Walker Systems, Inc.; Wiremold Company (The).
- c. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
 - 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. Butler Manufacturing Company; Walker Division.
 - b. Enduro Systems, Inc.; Composite Products Division.
 - c. Hubbell Incorporated; Wiring Device-Kellems Division.
 - d. Lamson & Sessions; Carlon Electrical Products.
 - e. Panduit Corp.
 - f. Walker Systems, Inc.; Wiremold Company (The).
 - g. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. Erickson Electrical Equipment Company.
 - Hoffman.
 - 4. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 5. RACO; a Hubbell Company.
 - 6. Thomas & Betts Corporation.
 - 7. Walker Systems, Inc.; Wiremold Company (The).
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy or aluminum], Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 - 1. Color of Frame and Cover: Gray.

- 2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
- 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- 5. Cover Legend: Molded lettering, "ELECTRIC." "TELEPHONE." for each service.
- 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- 7. Handholes 36 inches wide by 48 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
- C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.
 - 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. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Christy Concrete Products.
 - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
- D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.
 - 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. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by a independent testing agency.

- 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
- 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: IMC.
 - 2. Concealed Conduit, Aboveground: IMC.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 5. Damp or Wet Locations: IMC.
 - 6. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway or EMT.
 - 7. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Risertype, optical fiber/communications cable raceway orEMT]
 - 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, in damp or wet locations.
- C. Minimum Raceway Size: [1/2-inch (16-mm)] [3/4-inch (21-mm)] trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hotwater pipes. Install horizontal raceway runs above water and steam piping.

- C. Complete raceway installation before starting conductor installation.
- D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- G. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to IMC before rising above the floor.
- H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- K. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- L. 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.
- M. Set metal floor boxes level and 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.
 - 2. Install backfill as specified.
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.

- 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
- 5. Install manufactured steel conduit elbows for building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
- 6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below the frost line, <Insert depth of frost line below grade at Project site> below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:

- 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
- 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed[or unless seismic criteria require different clearance].
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry[and with approved joint compound for gypsum board assemblies].
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.8 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS & RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks.
 - Handholes and boxes.
 - Manholes.

1.3 SUBMITTALS

- A. Product Data: For accessories for manholes, handholes, and boxes.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Reinforcement details.
 - 3. Grounding details.
 - 4. Joint details.
- C. Shop Drawings for Factory-Fabricated Handholes and Boxes: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - Cover design.
 - 3. Grounding details.
 - 4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
- D. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cantex, Inc.
 - 2. CertainTeed Corp.; Pipe & Plastics Group.
 - 3. Condux International, Inc.
 - 4. Electri-Flex Company.
 - Lamson & Sessions; Carlon Electrical Products.
- C. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

D. Duct Accessories:

- Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
- 2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.3 HANDHOLES AND BOXES

- A. Description: Comply with SCTE 77.
 - 1. Color: Green.
 - 2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - Cover Legend: Molded lettering, "ELECTRIC." "TELEPHONE." As indicated for each service.

- 6. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of fiberglass.
 - 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. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.

2.4 PRECAST MANHOLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carder Concrete Products.
 - 2. Christy Concrete Products.
 - 3. Elmhurst-Chicago Stone Co.
 - 4. Oldcastle Precast Group.
 - 5. Riverton Concrete Products; a division of Cretex Companies, Inc.
 - 6. Utility Concrete Products, LLC.
 - 7. Utility Vault Co.
 - 8. Wausau Tile, Inc.
- C. Comply with ASTM C 858 and with interlocking mating sections, complete with accessories, hardware, and features.
 - Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
- D. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.
- E. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.5 UTILITY STRUCTURE ACCESSORIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Bilco Company (The).

- 2. Campbell Foundry Company.
- 3. Carder Concrete Products.
- 4. Christy Concrete Products.
- 5. East Jordan Iron Works, Inc.
- 6. Elmhurst-Chicago Stone Co.
- 7. McKinley Iron Works, Inc.
- 8. Neenah Foundry Company.
- 9. Oldcastle Precast Group.
- 10. Pennsylvania Insert Corporation.
- 11. Strongwell Corporation; Lenoir City Division.
- 12. Underground Devices, Inc.
- 13. Utility Concrete Products, LLC.
- B. Manhole Frames and Covers: Comply with structural design loading specified for manhole.
 - 1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 26 inches.
 - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
 - 2. Cover Legend: Cast in. Selected to suit system.
 - Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
 - b. Legend: "SIGNAL" for communications, data, and telephone duct systems.
- C. Manhole Sump: Depression cast in floor.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- diameter eye, and 1-by-4-inch bolt.
 - 1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- E. Pulling Eyes in Non-concrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- diameter eye, rated 2500-lbf minimum tension.
- F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
 - 1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
 - 1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.
- I. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.
 - 1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.
 - 2. Arms: 1-1/2 inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 18 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
 - 3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

- J. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- K. Cover Hooks: Light duty, designed for lifts less than 60 lbf, Two required.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and Backfill: Do not use heavy-duty, hydraulic-operated, compaction equipment.

3.2 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
 - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and

to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

- 2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
- 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
- 4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
- 5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
- 6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
- 7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
- 8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
- 9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
- 10. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

I. Direct-Buried Duct Banks:

- Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
- 2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers
- 3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches in nominal diameter.
- 4. Install backfill as specified in Division 31 Section "Earth Moving."

- 5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
- 6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
- 7. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.
- 8. Set elevation of bottom of duct bank below the frost line.
- 9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
- 10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.3 INSTALLATION OF CONCRETE MANHOLES

- A. Comply with ASTM C 891, unless otherwise indicated.
- B. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
- C. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- D. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
- E. Manhole Frame: In paved areas and traffic ways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
- F. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
- G. Hardware: 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.
- H. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.4 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box

extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

- B. Unless otherwise indicated, support units on a 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 and traffic ways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for outof-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
 - Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.7 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Identification for raceways.
- 2. Identification of power and control cables.
- 3. Identification for conductors.
- 4. Underground-line warning tape.
- 5. Warning labels and signs.
- 6. Instruction signs.
- 7. Equipment identification labels.
- 8. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.
- E. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage[and system or service type.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

- 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
- 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
- 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

- 1. Comply with ANSI Z535.1 through ANSI Z535.5.
- 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE
- 3. Inscriptions for Orange-Colored Tapes: COMMUNICATIONS CABLE.

2.6 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - Multiple Power Source Warning: "DANGER ELECTRICAL SHOCK HAZARD -EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING OSHA REGULATION AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.7 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

2.9 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black except where used for color-coding.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30> A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

- 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
 - a. Color shall be factory applied[or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit].
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- G. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- H. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

- a. Indoor Equipment: Adhesive film label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label [tenciled legend 4 inches (100 mm) high.
- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Switchgear.
- e. Switchboards.
- f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- g. Substations.
- h. Emergency system boxes and enclosures.
- i. Enclosed switches.
- j. Enclosed circuit breakers.
- k. Enclosed controllers.
- I. Variable-speed controllers.
- m. Push-button stations.
- n. Power transfer equipment.
- o. Contactors.
- p. Receptacles.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Power-generating units.
- s. Monitoring and control equipment.

END OF SECTION 260553

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
 - Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.

1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional Engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
 - 1. CGI CYME.
 - 2. EDSA Micro Corporation.
 - 3. ESA Inc.
 - 4. Operation Technology, Inc.
 - 5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 - 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - Product Data for overcurrent protective devices specified in other Division 16 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance of utility service entrance.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - e. Busway ampacity and impedance.
 - f. Motor horsepower and code letter designation according to NEMA MG 1.
 - 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Ratings, types, and settings of utility company's overcurrent protective devices.
 - e. Special overcurrent protective device settings or types stipulated by utility company.
 - f. Time-current-characteristic curves of devices indicated to be coordinated.
 - g. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.

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i. Panelboards, switchboards, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 - 1. Switchgear and switchboard bus.
 - 2. Distribution panelboard.
 - 3. Branch circuit panelboard.

- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 - 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
 - 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report:

- 1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
- 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
 - 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 - 2. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.

- Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
- 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 - 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- G. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION 260573

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Indoor occupancy sensors.
 - 3. Lighting controllers.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Intermatic, Inc.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lightolier Controls; a Genlyte Company.
 - 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 5. Square D; Schneider Electric.
 - 6. TÖRK.
 - 7. Touch-Plate, Inc.
 - 8. Watt Stopper (The).
- B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 - 1. Contact Configuration: SPST or DPST as required.
 - 2. Contact Rating: 30-A inductive or resistive.
 - 3. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
 - 4. Program: 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
 - 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
 - 6. Astronomic Time: All channels.
 - 7. Battery Backup: For schedules and time clock.

2.2 INDOOR OCCUPANCY SENSORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hubbell Lighting.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 4. Novitas, Inc.
 - 5. RAB Lighting, Inc.
 - 6. Sensor Switch, Inc.
 - 7. Watt Stopper (The).
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

- 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
- 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
- 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
- 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
- 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
- 6. Bypass Switch: Override the on function in case of sensor failure.
- 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
- C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
 - 1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
 - 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.

2.3 LIGHTING CONTROLLERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Allen-Bradlev/Rockwell Automation.
 - 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 - 3. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 4. Hubbell Lighting.
 - 5. Lutron.
 - 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 7. Square D; Schneider Electric.
- B. Description: Electrically operated and fully programmable lighting controller with multiple subpanel control options. Provide one master station on Garden Level Floor and two (2) separate controllers for each upper floor in Phase I. For Phase II, provide one (1) separate controller for each of the levels. Provide a minimum of Twelve Channels on each subpanel to be controlled as programmed in the Main Controller complying with NEMA ICS 2 and UL 508. Program the circuit switching as directed by the Engineer/Owner at time of substantial completion. Follow plans for circuiting requirements.

- 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
- 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
- 3. Enclosure: Comply with NEMA 250.
- 4. Provide with control and pilot devices as indicated and matching the NEMA type specified for the enclosure.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 22 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTROLLER INSTALLATION

A. Mount per manufacturers installation requirements...

3.3 WIRING INSTALLATION

- A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- B. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- 1. Identify controlled circuits in lighting controllers.
- Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label controllers with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing Controllers after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting and programming to suit occupied conditions.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting controllers.

END OF SECTION 260923

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - Distribution transformers.

1.3 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
 - 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 and their installation requirements.
- C. Qualification Data: For testing agency.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- B. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchorbolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. ACME Electric Corporation: Power Distribution Products Division.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 3. General Electric Company.
 - 4. Hammond Co.: Matra Electric. Inc.
 - 5. Magnetek Power Electronics Group.
 - 6. Siemens Energy & Automation, Inc.
 - 7. Sola/Hevi-Duty.
 - 8. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Aluminum.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: ANSI 49 gray.
- E. Taps for Transformers Smaller Than 3 kVA: None.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- J. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Remove and replace units that do not pass tests or inspections and retest as specified above.
- C. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.

1.3 SUBMITTALS

- A. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

B. Field Quality-Control Reports:

- 1. Test procedures used.
- 2. Test results that comply with requirements.
- 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- C. Panelboard Schedules: For installation in panelboards.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

1.6 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchorbolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1
 - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 3. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - 4. Directory Card: Inside panelboard door, mounted in transparent card holder

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- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
 - 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 - Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

2.2 DISTRIBUTION PANELBOARDS

- 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. Eaton Electrical Inc.: Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm)high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in or Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Overcurrent Protective Devices: Fused switches.

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2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- 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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.
- B. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.

- E. Install filler plates in unused spaces.
- F. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- G. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.

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- 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
- 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
- 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Snap switches and wall-box dimmers.
 - 4. Communications outlets.
 - 5. Pendant cord-connector devices.
 - 6. Cord and plug sets.
 - 7. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed or non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper: GF20.
 - b. Pass & Seymour; 2084.

2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.

2.5 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
 - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Pilot Light Switches, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
 - 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
 - 2. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.8 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.9 OCCUPANCY SENSORS

A. Wall-Switch Sensors:

- 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Watt Stopper (The); WS-200.
- 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

2.10 COMMUNICATIONS OUTLETS

- A. Telephone Outlet:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 3560-6.
 - b. Leviton; 40649.
 - 2. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 6. Comply with UL 1863.
- B. Combination TV and Telephone Outlet:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 3562.
 - b. Leviton; 40595.
 - 2. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 6; and one Type F coaxial cable connector.

2.11 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic] [0.035-inch- (1-mm-) thick or satin-finished stainless steel 0.04-inch- (1-mm-) thick.
 - 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant die-cast aluminum with lockable cover.

2.12 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.

2.13 POKE-THROUGH ASSEMBLIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
 - 3. Square D/ Schneider Electric.
 - 4. Thomas & Betts Corporation.
 - 5. Wiremold Company (The).
- B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
 - 1. Service Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 iacks.
 - 2. Size: Selected to fit nominal 4-inch (100-mm) cored holes in floor and matched to floor thickness.
 - 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 - 4. Closure Plug: Arranged to close unused[4-inch (100-mm) cored openings and reestablish fire rating of floor.
 - 5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, 4-pair, Category 5e voice and data communication cables.

2.14 MULTIOUTLET ASSEMBLIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold Company (The).
- B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: Metal, with manufacturer's standard finish.
- D. Wire: No. 12 AWG.

2.15 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

- 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
- 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
- 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
- 4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

- 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
- 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
- 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

- 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
- 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
- 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
- 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
- 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.

- 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
- 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
- 8. Tighten unused terminal screws on the device.
- 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

- 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

- 1. Install dimmers within terms of their listing.
- 2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 - 2. Test Instruments: Use instruments that comply with UL 1436.
 - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.

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6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Cartridge fuses rated 600 V and less.

1.2 SUBMITTALS

- A. Product Data: For each fuse type indicated.
- 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. Comply with NEMA FU 1.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussman, Inc.
 - 2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

FUSES 262813 - 1

PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

- A. Service Entrance: Class L, time delay 6r J, time delay.
- B. Feeders: Class L, time delay 6r J, time delay.
- C. Motor Branch Circuits: Class RK5, time delay.
- D. Other Branch Circuits: Class RK5, time delay 6r J, time delay.

3.2 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 262813

FUSES 262813 - 2

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Molded-case switches.
 - 6. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

- 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Manufacturer's field service report.
- E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. 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.
- C. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- 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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:

- Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
- 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
- 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
- 4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

- 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. Eaton Electrical Inc.: Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw,600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

- Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
- 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
- 3. Hookstick Handle: Allows use of a hookstick to operate the handle.
- 4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- 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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Features and Accessories:

- 1. Standard frame sizes, trip ratings, and number of poles.
- 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
- 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

- 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
- 2. Test continuity of each circuit.

B. Tests and Inspections:

- 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Ballast, including BF.
 - 3. Energy-efficiency data.
 - 4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
- B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

- Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Installation instructions for each type of fixture.
- D. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
- G. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- C. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp and ballast characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
 - Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
 - d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
 - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
 - f. CCT and CRI for all luminaires.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. General Requirements for Electronic Ballasts:
 - 1. Comply with UL 935 and with ANSI C82.11.
 - 2. Designed for type and quantity of lamps served.
 - 3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
 - 4. Total Harmonic Distortion Rating: Less than 20]percent.
 - 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 - 6. Operating Frequency: 42 kHz or higher.
 - 7. Lamp Current Crest Factor: 1.7 or less.
 - 8. BF: 0.88 or higher.
 - 9. Power Factor: 0.95 or higher.
 - 10. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
- B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.
- C. Electronic Programmed-Start Ballasts for Lamps: Comply with ANSI C82.11 and the following:
 - 1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
 - 2. Automatic lamp starting after lamp replacement.
- D. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

- E. Ballasts for Low-Temperature Environments:
 - 1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
- F. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
 - 1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 - 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 - 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
 - 4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.
- G. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.
 - 1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 30 percent of rated lamp lumens.
 - 2. Ballast shall provide equal current to each lamp in each operating mode.
 - 3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
 - 1. Lamp end-of-life detection and shutdown circuit.
 - 2. Automatic lamp starting after lamp replacement.
 - 3. Sound Rating: Class A.
 - 4. Total Harmonic Distortion Rating: Less than 20 percent.
 - 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 - 6. Operating Frequency: 20 kHz or higher.
 - 7. Lamp Current Crest Factor: 1.7 or less.
 - 8. BF: 0.95 or higher unless otherwise indicated.
 - 9. Power Factor: 0.95 or higher.
 - 10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.5 BALLASTS FOR HID LAMPS

- A. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
 - 1. Minimum Starting Temperature: Minus 20 deg F (Minus 29 deg C) for single-lamp ballasts.
 - 2. Rated Ambient Operating Temperature: 130 deg F (54 deg C).
 - 3. Lamp end-of-life detection and shutdown circuit.

- 4. Sound Rating: Class A.
- 5. Total Harmonic Distortion Rating: Less than 20 percent.
- 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
- 7. Lamp Current Crest Factor: 1.5 or less.
- 8. Power Factor: 0.90 or higher.
- 9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
- 10. Protection: Class P thermal cutout.

2.6 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channeland angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel,12 gage (2.68 mm).
- E. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures:
 - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
 - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

- Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners
- 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
- 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
- 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

D. Suspended Lighting Fixture Support:

- 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
- 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
- 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to generator and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

END OF SECTION 265100

150 PARK AVENUE, PATERSON, NJ 07501 BLOCK: 4101 LOT: 6

GENERAL NOTES

DRAWINGS ARE NOT TO BE SCALED. DIMENSIONS ARE PROVIDED TO INDICATE DESIGN INTENT ONLY. LARGE—SCALE DETAILS SHALL SUPERSEDE SMALLER SCALE DRAWINGS. LOWER LEVEL

1). COORDINATE THE WORK OF ALL TRADES AND THE OWNER'S REQUIREMENTS FOR ALL WORK INDICATED IN THESE CONTRACT DOCUMENTS AND ASSUME FINAL RESPONSIBILITY FOR ALL CONSTRUCTION COORDINATION.

2). VERIFY ALL EXISTING CONDITIONS, DIMENSIONS, ETC. AT THE SITE. REPORT ANY DISCREPANCIES TO THE ARCHITECT IN WRITING PRIOR CONSTRUCTION. ANY SURFACES REQUIRING REPAIR FOR PROPER INSTALLATION OF NEW FINISHES MUST BE INCLUDED IN THE BASE BID. CONTRACTOR SHALL ALSO COORDINATE WORK WITH THE WORK OF OTHER TRADES.

3). SUBMISSION OF BID ACKNOWLEDGES THAT THE CONTRACTOR HAS VISITED THE SITE AND IS SUFFICIENTLY FAMILIAR WITH ALL PERTINENT CONDITIONS FOR A RESPONSIVE AND MEANINGFUL BID.

4). BE RESPONSIBLE FOR ALL DEMOLITION AS REQUIRED FOR COMPLETION OF THE PROJECT. REMOVE ALL DEMOLISHED MATERIALS, NOT DESIGNED FOR REUSE, FROM THE PREMISES. REMOVE ALL DEBRIS FROM THE SITE & LEAVE THE PREMISES CLEAN, NEAT AND ORDERLY AT THE COMPLETION OF THE PROJECT.

5). BE RESPONSIBLE FOR MAINTAINING THE SECURITY OF THE BUILDING THROUGHOUT THE PROJECT TO FINAL COMPLETION AND OWNER'S ACCEPTANCE. COOPERATE WITH BUILDING MANAGEMENT ON SECURITY PROCEDURES.

6). PERFORM ALL WORK SHOWN ON THESE DRAWINGS UNLESS SPECIFICALLY NOTED OTHERWISE.

7). OBTAIN ALL PERMITS, INSPECTIONS AND CERTIFICATES NECESSARY FOR OCCUPANCY U.N.O., TEMPORARY CERTIFICATE OF OCCUPANCY (T.C.O.) OR C. OF O. AS A PRE-REQUISITE TO FINAL PAYMENT FOR THE WORK INDICATED IN THESE CONTRACT DOCUMENTS, AT THE COMPLETION OF THIS PHASE (OR PROJECT).

8). CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL REQUIRED PERMITS; INCLUDE COST OF PERMITS IN BID (UNLESS MODIFIED PER AGREEMENT) ALL WORK SHALL CONFORM TO THE REQUIREMENTS OF ALL APPLICABLE CODES, LAWS, RULES, AND REGULATIONS OF ALL CONSTITUTED AUTHORITIE HAVING JURISDICTION

9). ALL NEW MATERIALS AND INSTALLATIONS SHALL BE IN ACCORDANCE WITH MANUFACTURER'S LATEST SPECIFICATION REQUIREMENTS AND IN ACCORDANCE WITH CURRENT CODE REQUIREMENTS.

10). DRAWINGS MAY NOT REPRESENT ALL EXISTING SITE CONDITIONS. CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF EXISTING CONDITIONS PRIOR TO ORDERING ANY MATERIALS OR PROCEEDING WITH THE WORK. CONTRACTOR TO NOTIFY ARCHITECT OF ANY DISCREPANCIES OF QUESTIONS AND OBTAIN REQUIRED CLARIFICATION PRIOR TO PROCEEDING WITH WORK.

11). NO CHANGE ORDERS WILL BE PERMITTED UNLESS SUBMITTED IN WRITING BY THE CONTRACTOR & APPROVED BY THE OWNER IN ADVANCE OF SUBMITTALS.

12). CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF ALL ITEMS, MATERIAL SAMPLES AND EQUIPMENT CUT—SHEET. SHOP DRAWINGS SHALL INCLUDE DETAILED FABRICATION AND ERECTION DRAWING, SETTING DRAWINGS, DIAGRAMMATIC DRAWINGS AND MATERIAL, ALL ITEMS SHALL BE CLEARLY INDICATED. FABRICATION SHALL BEGIN ONLY AFTER RECEIVING APPROVED SHOP DRAWINGS.

13). PROVIDE MINIMUM OF (1) ONE—YEAR WARRANTY OF ALL WORKMANSHIP.

14). PUNCHLIST TO BE PROVIDED, IF REQUESTED, ONLY AFTER RECEIPT OF TEMPORARY CERTIFICATE OF OCCUPANCY (T.C.O.).

15). GC TO CONTACT 'NEW JERSEY ONE CALL' AT 811 OR 800-272-1000 AS REQUIRED BY LAW PRIOR TO ANY DIGGING.

16). PROVIDE PROPER PROTECTION FOR ALL EXISTING WORK, OUTDOOR FURNITURE, MATERIALS, FOLIPMENT, FIXTURES, AND LANDSCAF

ARE LIKELY TO BE DAMAGED DUISING CONSTRUCTION.

17). BE RESPONSIBLE FOR SCHEDULING AND COORDINATION OF ALL TRADES INCLUDING THOSE NOT DIRECTLY IN THEIR EMPLOY.

18). CONTRACTOR TO PREPARE COORDINATION DRAWINGS OF ALL TRADES PRIOR TO ORDERING ANY AND/OR ALL MATERIALS INCLUDING LEAD ITEMS.

19). ALL NEW MATERIALS AND INSTALLATIONS SHALL BE IN ACCORDANCE WITH MANUFACTURER'S LATEST SPECIFICATION REQUIREMENTS AND IN

GENERAL DEMOLITION NOTES:

 ALL DIMENSIONS ON THIS DRAWING ARE APPROXIMATE. GENERAL CONTRACTOR IS RESPONSIBLE TO FIELD VERIFY AND COORDINATE ALL DIMENSIONS WITH ARCHITECT AND RELATED TRADES.
 ALL MAJOR DEMOLITION WORK AS INDICATED IS REQUIRED TO BE PERFORMED IN A SEQUENCE SO AS NOT TO DELAY THE WORK OF ANY OTHER TRADE.

3.) REMOVAL OF DEBRIS TO ENSURE MINIMUM INTERFERENCE WITH ROAD, STREETS, WALKS, AND OTHER ADJACENT OCCUPIED OR USED FACILITIES.

4.) THE GENERAL CONTRACTOR SHALL NOTIFY OWNER PRIOR TO BEGINNING ANY DEMOLITION ON THE SITE.

5.) PROMPTLY REPAIR DAMAGES CAUSED BY DEMOLITION OPERATIONS AT NO COST TO OWNER.

6.) MATERIALS REMOVED FROM DEMOLISHED STRUCTURES TO BE TRANSPORTED AND LEGALLY DISPOSED OF OFF-SITE. CONTRACTOR IS

PERPONSIBLE FOR THE REMOVAL AND DISPOSAL OF ALL DEMOLISHED MATERIALS.

RÉSPONSIBLE FOR THE REMOVAL AND DISPOSAL OF ALL DEMOLISHED MATERIALS.
7.) INSPECT AND OBSERVE EXISTING CONDITIONS PRIOR TO DEMOLITION.

8.) BURNING OF REMOVED MATERIALS FROM THE DEMOLISHED STRUCTURES WILL NOT BE PERMITTED ON SITE.

9.) REMOVE DEBRIS. RUBBISH, AND OTHER MATERIALS RESULTING FROM DEMOLITION OPERATIONS. PREMISES MUST BE LEFT BROOM CLEAN

AND READY FOR NEW CONSTRUCTION.

10.) DURING DEMOLITION AND REMOVAL, THE CONTRACTOR SHALL NOTIFY THE ARCHITECT, IN WRITING, OF ANY UNEXPECTED OR UNUSUAL

11.) CONTRACTOR IS TO PROVIDE THE NECESSARY PROTECTION TO THE PORTIONS OF PRESENT STRUCTURE INTENDED TO BE INCORPORATED INTO COMPLETED WORK.

12.) CONTRACTOR IS TO TAKE ALL NECESSARY MEASURES TO PREVENT DAMAGE TO ANY ADJACENT PROPERTY AND PERSONS.

13.) CONTRACTOR IS TO PROVIDE ALL NECESSARY SHORING AND BRACING, SO AS NOT TO UNDERMINE EXISTING STRUCTURE. TAKE ALL

NECESSARY MEASURES TO PREVENT THE COLLAPSE OF ANY REMAINING STRUCTURE, ETC.

14.) PROTECT EXISTING UTILITIES AND SERVICES AGAINST DAMAGE DURING DEMOLITION OPERATIONS. 15.) CONTRACTOR SHALL NOTIFY OWNER PRIOR TO ANY UTILITY SHUTDOWN DURING DEMOLITION.

16.) CONTRACTOR TO NOTIFY ALL RESPECTIVE UTILITY COMPANIES PRIOR TO START OF DEMOLITION.

17.) CONTRACTOR TO VERIFY ALL UTILITY LOCATIONS PRIOR TO THE START OF DEMOLITION. (I.E.: GAS, ELECTRICAL, SEWER, ETC.)

18.) ALL EXISTING STRUCTURE TO REMAIN, UNLESS NOTED OTHERWISE.19.) CONTRACTOR TO PREP AND FLASH PATCH EXISTING FLOOR THROUGHOUT TO I

19.) CONTRACTOR TO PREP AND FLASH PATCH EXISTING FLOOR THROUGHOUT TO ENSURE EXISTING SLAB IS LEVEL FOR NEW FLOOR INSTALLATION

20.) CONTRACTOR TO REMOVE ALL PARTITIONS AS SHOWN ON DRAWINGS, IN ENTIRETY TO FLOOR SLAB UNLESS OTHERWISE NOTED.
21.) NOTIFY ARCHITECT IF ANY STRUCTURAL MEMBERS ARE UNCOVERED DURING DEMOLITION. KEEP ARCHITECT ADVISED OF PROGRESS.
22.) ANY DAMAGE TO EXISTING SPACES TO REMAIN AS A RESULT OF DEMOLITION MUST BE PATCHED/REPAIRED TO MATCH EXISTING.

23.) CONTRACTOR RESPONSIBLE FOR DISPOSAL OF ALL REMOVED MATERIAL.

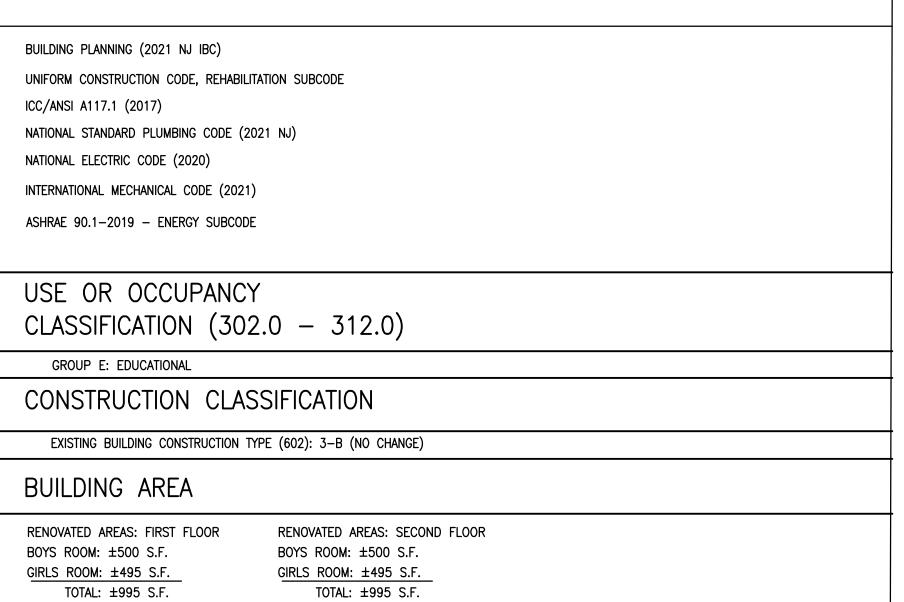
24.) THE GENERAL CONTRACTOR IS RESPONSIBLE TO REPAIR/REPLACE AND PAINT ANY DAMAGED PARTITIONS DUE TO THE DEMOLITION OR INSTALLATION OF ALL FIXTURES, WATER PIPING, VENT PIPING, SANITARY PIPING AND CERAMIC TILE. CONSTRUCTION MANAGER TO GIVE DIRECTION AS TO REQUIRED LOCATIONS AND EXTENT OF REPAIR WORK AFTER DEMOLITION AND NEW FIXTURE AND PIPING INSTALLATION

OCCURS.
25.) GENERAL CONTRACTOR IS RESPONSIBLE TO PERFORM ANY AND ALL CUTTING AND PATCHING REQUIRED FOR ALL FIXTURE, CARRIER, WATER PIPING, SANITARY PIPING AND VENT PIPING DEMOLITION OR INSTALLATION. THIS WORK SHALL BE COVERED AND INCLUDED UNDER

ACM GENERAL NOTES

THE GENERAL CONTRACTORS BASE BID PRICE.

IT HAS BEEN DETERMINED BUILDING MATERIALS WITHIN THE AREA OF WORK AS PART OF THIS PROJECT MAY CONTAIN ASBESTOS (ACM). REFER TO DISTRICTS AHERA REPORT FOR ADDITIONAL INFORMATION. ALL ASSOCIATED MATERIALS WILL BE REMOVED UNDER SEPARATE CONTRACT BY A LICENSED ABATEMENT COMPANY RETAINED BY THE SCHOOL FOR THE CONTRACTOR TO COMPLETE HIS CONSTRUCTION WORK AS IDENTIFIED WITHIN THESE DOCUMENTS. CONTRACTOR IS RESPONSIBLE TO FULLY COORDINATE THE SEQUENCE OF WORK WITH THE ABATEMENT CONTRACTOR TO ASSURE ALL CONTAMINATED MATERIALS ARE PROPERLY REMOVED TO EXECUTE THE PROJECT. IF THE CONTRACTOR FINDS ANY MATERIAL THEY THINK CONTAINS ASBESTOS BEYOND WHAT HAS BEEN IDENTIFIED, THEY MUST NOTIFY THE SCHOOL'S REPRESENTATIVE IMMEDIATELY. THE SCHOOL WILL HAVE THE MATERIAL TESTED THEN PROPERLY REMOVED BY THE ABATEMENT CONTRACTOR IF REQUIRED.



		 	 ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
NUMBER	DRAWING NAME		ISSUES	AND REVISIOI	NS	
			PROGRESS SET FEBRUARY 7, 2025			_
ARCHITECTU	RAL DRAWINGS					

C-1	COVER SHEET	•	
D-1	ENLARGED GIRLS & BOYS FIRST AND SECOND FLOOR BATHROOM DEMOLITION PLANS, ADA REQUIREMENT, SIGNAGE NOTES & DETAILS.	•	
A-1	ENLARGED FIRST FLOOR GIRLS & BOYS BATHROOM CONSTRUCTION PLANS, PARTITION SCHEDULE, FINISH SCHEDULE & DETAILS.	•	
A-2	ENLARGED SECOND FLOOR GIRLS & BOYS BATHROOM CONSTRUCTION PLANS, DOOR SCHEDULE & DETAILS.	•	
A-3	ENLARGED FIRST AND SECOND FLOOR GIRLS & BOYS BATHROOM RCP / HVAC PLAN & DETAILS.		
A-4	ENLARGED FIRST AND SECOND FLOOR GIRLS & BOYS PLUMBING PLANS & DETAILS	•	
A-5	ENLARGED FIRST AND SECOND FLOOR GIRLS & BOYS ELEVATIONS.	•	

SCOPE OF WORK DESCRIPTION:

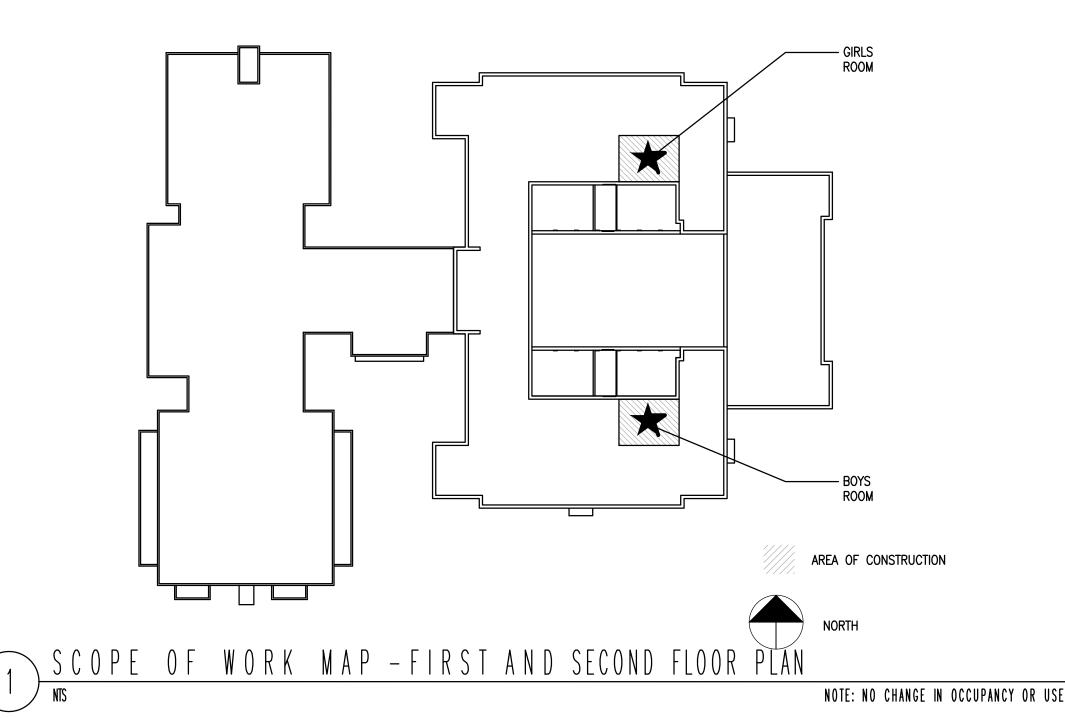
CODE ANALYSIS

TOTAL AREA OF CONSTRUCTION: ±1990 S.F.

DRAWING LIST

SCOPE OF WORK INCLUDES, BUT IS NOT LIMITED TO THE INTERIOR RENOVATION OF THE PUBLIC BOYS & GIRLS ROOM LOCATED ON THE FIRST AND SECOND FLOOR. INCLUDED IN THE PROJECT IS THE REMOVAL AND REPLACEMENT OF ALL CEILINGS, PLUMBING FIXTURES, TOILET COMPARTMENTS, TOILET ACCESSORIES, LIGHTING FIXTURES, DOOR / DOOR HARDWARE, ELECTRICAL COMPONENTS, ETC. SCOPE OF WORK DOES NOT INCLUDE WORK TO THE EXISTING BUILDING. REFER TO BID DRAWINGS FOR ADDITIONAL REQUIREMENTS.







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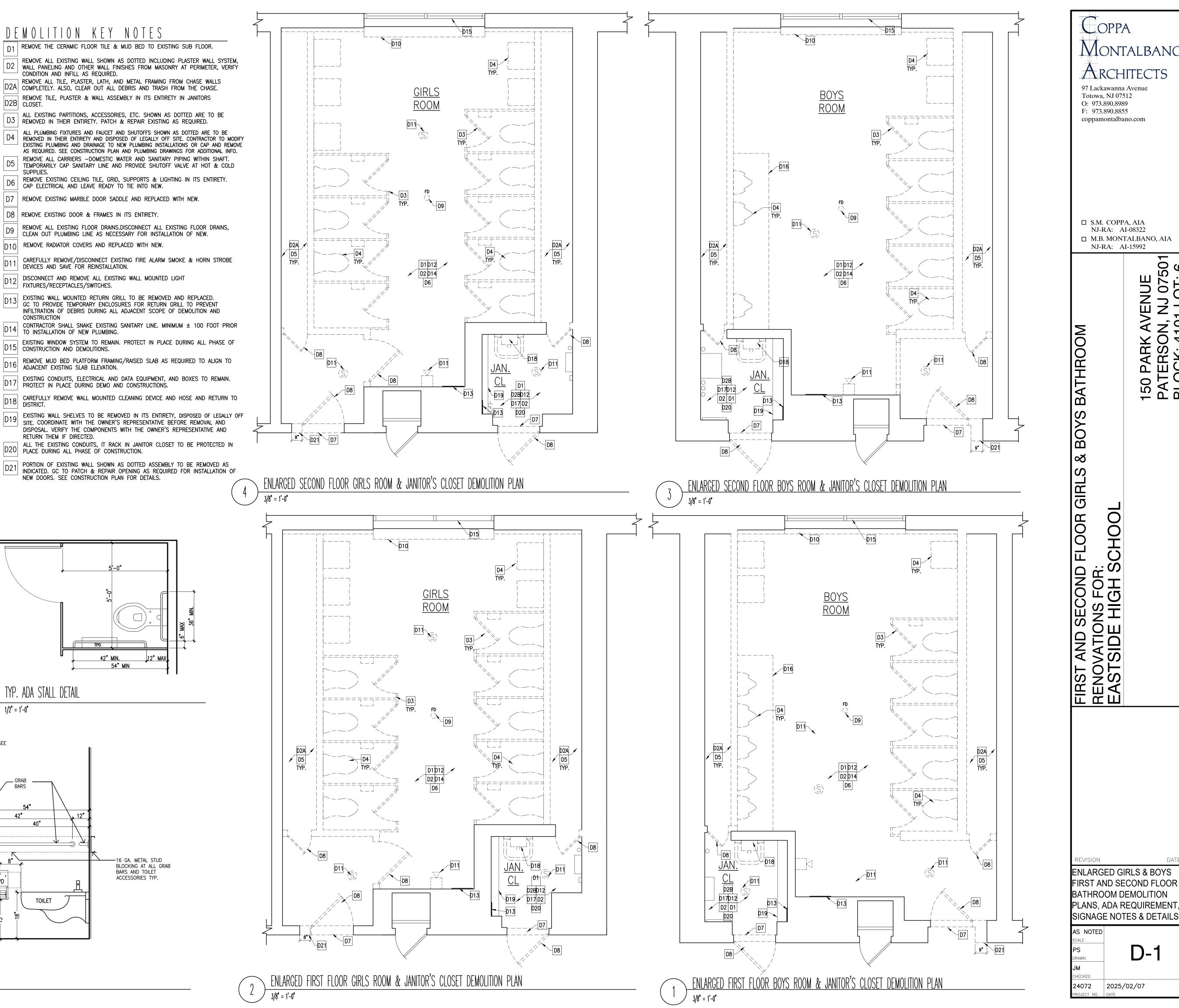
50 PARK AVENUE PATERSON, NJ 0750

FIRST AND SECOND FLOOR GIRI RENOVATIONS FOR: EASTSIDE HIGH SCHOOL

/ISION DA

COVER SHEET

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Montalbano

ARCHITECTS

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0

2025/02/07

☐ M.B. MONTALBANO, AIA

0 0'

1001

AVENUE N, NJ 075 101 LOT:

150 PARP PATERS(BLOCK: 4

O: 973.890.8989

F: 973.890.8855

CONDITION AND INFILL AS REQUIRED.

DEVICES AND SAVE FOR REINSTALLATION.

FIXTURES/RECEPTACLES/SWITCHES.

TO INSTALLATION OF NEW PLUMBING.

ADJACENT EXISTING SLAB ELEVATION.

D15 construction and demolitions.

RETURN THEM IF DIRECTED.

1/2" = 1'-0"

TOILET PARTITIONS. SEE

TPD

TOILET PAPER----

DISPENSER

CONSTRUCTION

ACCESSIBILITY REQUIREMENTS

PER UCC 5:23-7.11

1. ALL TOILET FACILITIES MUST BE ACCESSIBLE. AT LEAST 1 FIXTURE OF EACH

2. WHERE WATER CLOSET COMPARTMENTS ARE PROVIDED IN A TOILET ROOM OR

BATHING FACILITY, AT LEAST ONE WHEELCHAIR ACCESSIBLE COMPARTMENT SHALL BE

CORIAN SOLID SURFACE

- MIRROR WITH STAINLESS STEEL

CONT. HORZ. WOOD BLOCKING

ALUM VANITY SUPPORT EQUAL TO

BOARD ON METAL STUD PARTITION.

SEE PARTITION SCHEDULE FOR

ADDITIONAL INFORMATION

PROVIDE SOLID CORIAN CLOSURE AT BOTTOM OF

2X BLOCKING W/ TEMPER RESISTANT SCREWS.

PROVIDE CORIAN CLOSURE AT

EXPOSED ENDS OF VANITY TYP.

- CORIAN SOLID SURFACE

TYPE MUST BE ACCESSIBLE IN EACH ACCESSIBLE TOILET FACILITY.

PROVIDED

NOTE: PROVIDE A SUPPORT BRACKET

BETWEEN EACH SINK AT COUNTER

SPACE (TYP.). DO NOT ALLOW ANY UNBRACED LENGTH GREATER THAN

CONT. CORIAN

SOLID SURFACE MOUNTED TO ALUM.

BRACKET SCREEN

VANITY INSTALLATION DETAIL

16 GA. METAL STUD BLOCKING AT ALL GRAB BARS AND TOILET

GRAB

TOILET

TOILET PAPER—

DISPENSER

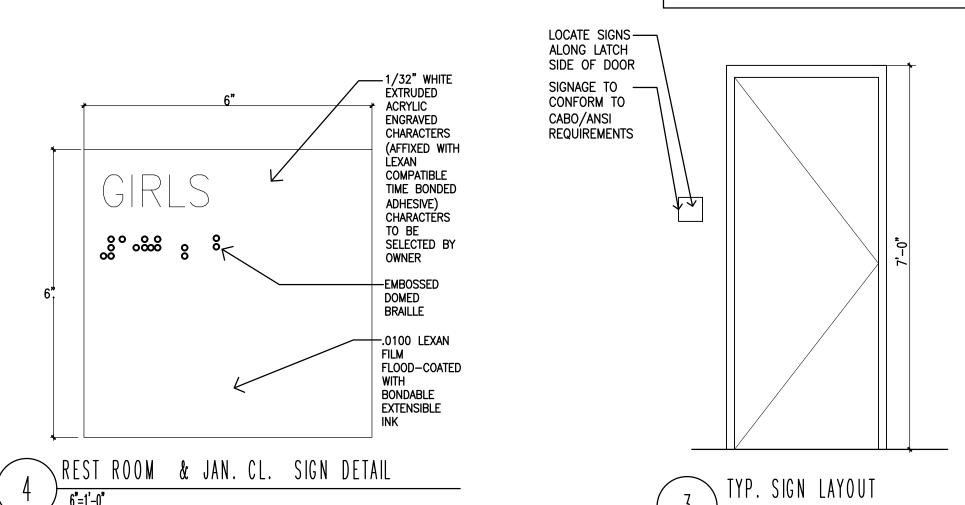
ACCESSORIES TYP.

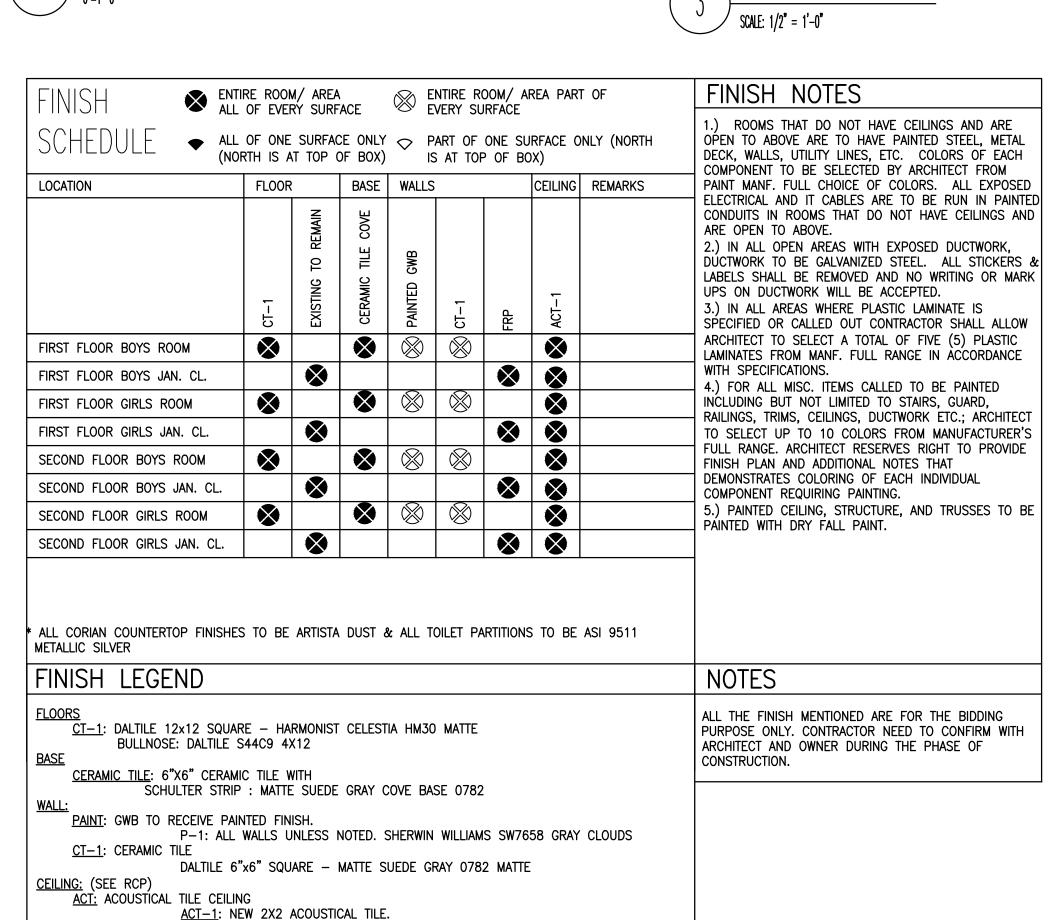
D2B CLOSET.

WALL PARTITIONS

TYPICAL NOTE:

ALL INTERIOR BATHROOM PARTITIONS ARE TO RECEIVE § C.B A.F.F AND WALL TILE TO 6'-0" A.F.F. PROVIDE W.R. § PAINTED GWB ABOVE TO UNDERSIDE OF STRUCTURE.





CONSTRUCTION PLAN SYMBOL LEGEND UNDERMOUNT SURFACE MOUNTED LAVATORY WITH SOAP DISPENSER SENSOR FAUCET. SEE PLUMBING FIXTURE SCHEDULE SURFACE MOUNTED WALL MOUNTED SLIP SANITARY NAPKIN SND RESISTANT GRAB DISPOSAL BARS. SEE TOILET ACCESSORY SCHEDULE SURFACE MOUNTED WALL MOUNTED WATER TOILET PAPER CLOSET. SEE • WC DISPENSER PLUMBING FIXTURE SCHEDULE WALL MOUNTED WALL MOUNTED TILT MIRROR URINAL. SEE (ADA COMPLIANT) PLUMBING FIXTURE **SCHEDULE** MOP SINK NEW FLOOR DRAIN, SEE PLUMBING $\rightarrow \bigoplus \ \epsilon$ SEE PLUMBING FIXTURE SCHEDULE SCHEDULE. EXISTING WALL TO NEW WALL TO BE INSTALLED. SEE WALL PARTITION SCHEDULE AND FINISH SCHEDULE HAND SANITIZER DISPENSER

INFORMATIONAL STRIPS: CONSTRUCTED OF LEXAN WITH SURFACE VINYL LETTERING.

COORDINATE & CONFIRM ALL SIGN MOUNTING HEIGHT LOCATIONS WITH ARCHITECT PRIOR TO INSTALLATION.

PROVIDE ONE SIGN PER NEW DOOR OPENING THROUGHOUT PROJECT, TYPICAL

SIGNAGE

BETWEEN BOTH PLATES.

ARCHITECT PRIOR TO INSTALL.

DETERMINED BY ARCHITECT AS MAXIMUM OCCUPANCY SIGNAGE

GENERAL NOTES

1. SIGN FACE: CONSTRUCTED OF LEXAN POLY CARBONATE FILM WHICH IS CAPABLE OF MEETING ALL ASTM SPECIFICATIONS AS TO PHYSICAL, OPTICAL, MECHANICAL, THERMAL, ELECTRICAL, AND FLAMMABILITY PROPERTIES. SIGN FACE IS A MINIMUM OF .0100" THICKNESS WITH MATTE FINISH. POCKETS FOR INFORMATIONAL STRIPS HAVE 1/16" MATTE ACRYLIC TOP PLATE. LEXAN SIGN FACE

IS SUBSURFACE PRINTED WITH A COMPATIBLE PIGMENT SYSTEM UTILIZING FORMULAS TESTED AND PROVEN TO HAVE BONDED REACTION WITH THE POLYCARBONATED SURFACE.SIGN COLOR TO BE

SUBSTRATE: CONSTRUCTED OF ACRYLIC WITH A MINIMUM THICKNESS OF 1/8". SPACING TAPE BETWEEN THE TOP PLATE AND THIS ACRYLIC SUBSTRATE FORMS POCKETS AND FINISHING EDGES

CONTRACTOR TO PROVIDE AND INSTALL (1) 12"X18" CLEAR FRAME PER ROOM THROUGHOUT BUILDING. CONTRACTOR TO COORDINATE INSTALL LOCATION WITH ARCHITECT PRIOR TO INSTALL

CONTRACTOR TO PROVIDE AREA OF REFUGE SIGN AT ALL AREA OF REFUGE LOCATION (3) TOTAL. SIGNS TO BE FABRICATED ACCORDING TO CODE AND TO BE FABRICATED IN SAME STYLE AS

CONTRACTOR TO PROVIDE AND INSTALL (1) 6"X6" CLEAR FRAME FOR EACH LAB, GYM, CAFETERIA, & AUDITORIUM IN BUILDING. CONTRACTOR TO COORDINATE INSTALL LOCATION WITH

1.REFER TO REFLECTED CEILING PLANS FOR ALL CEILING HEIGHTS.

2.REFER TO FLOOR PLANS FOR ALL OVERALL DIMENSIONS.

3.PROVIDE SOLID WOOD BLOCKING IN METAL STUD PARTITIONS AT ALL FIXTURES AND TOILET ACCESSORIES MOUNTING LOCATIONS.

4.PROVIDE WALL BUMPERS AT ALL LOCATIONS WHERE WALL IS 6" OR LESS FROM HINGED SIDE OF DOOR FRAME. THIS INCLUDE TOILET PARTITIONS.

5.TOILET ACCESSORIES' MOUNTING HEIGHT MAY DIFFER PER MANUFACTURER. ALL MOUNTING HEIGHTS TO BE ADA COMPLIANT.

6.G.C. IS REQUIRED TO FURNISH AND INSTALL ALL REQUIRED FIXTURE CARRIER. REFER TO

MANUFACTURERS RECOMMENDATIONS FOR MAKES AND MODELS.

9.GC IS REQUIRED TO SNAKE EXISTING SANITARY SEWER LINE TO MAIN. APPROX. 75'.

7.NEW FLOOR DRAINS ARE TO BE EQUIPPED WITH TRAP PRIMERS AND ASSOCIATED WATER LINE. 8.DO NOT SCALE TOILET ELEVATIONS. FIXTURES AND TILE ARE SHOWN SCHEMATICALLY.

10.EXISTING FLOOR DRAIN TO REMAIN. COORDINATE EXACT ROUTING LOCATION IN FIELD. G.C. TO PROTECT DURING CONSTRUCTION.

11.ALL EXISTING SOAP DISPENSERS, TOILET PAPER DISPENSERS, MIRRORS, PAPER TOWEL DISPENSERS,

ETC. ARE TO BE REMOVED. COORDINATE WITH OWNERS REPRESENTATIVES AND RETURN COMPONENTS IF DIRECTED OR LEGALLY DISPOSE OF OFF SITE.

12.ALL EXISTING TOILET PARTITIONS AND GRAB BARS ARE TO BE REMOVED AND REPLACED WITH NEW.

12.ALL EXISTING TOILET PARTITIONS AND GRAB BARS ARE TO BE REMOVED AND REPLACED WITH NEW.

13.REMOVE ALL CERAMIC FLOOR TILE AND ASSOCIATED MUD BED DOWN TO CONC. FLOOR SLAB. TYP. ENTIRE SPACE.

CONSTRUCTION KEY NOTES

C1 INSTALL NEW CERAMIC FLOOR TILE & MUD BED OVER EXISTING CONCRETE FLOOR. SEE DETAIL.

C2 EXISTING WINDOW SYSTEM TO REMAIN.

PROVIDE NEW TOILET PARTITION, BATHROOM ACCESSORIES AS SHOWN ON SCHEDULE AT ENTIRE ROOM.

PROVIDE NEW PLUMBING FIXTURES, FAUCET & SHUTOFFS AT ENTIRE ROOM. SEE PLUMBING FIXTURE SCHEDULE.

CONNECT SANITARY LINE AND PROVIDE SHUTOFF VALVE AT HOT & COLD SUPPLIES AS REQUIRED.

CONTRACTOR SHALL SNAKE EXISTING SANITARY LINE. MINIMUM ± 100 FOOT OF SEWER TO REMAIN PRIOR TO INSTALLATION OF NEW PLUMBING.

C7 NEW MARBLE DOOR SADDLE. SEE DETAIL.

C8 NEW DOOR & FRAMES. SEE DOOR SCHEDULE.

C9 NEW FLOOR DRAINS, SEE PLUMBING FIXTURE SCHEDULE & DETAIL.

C10 PROVIDE NEW PERFORATED METAL COVERS FOR EXISTING RADIATORS. VERIFY LENGTH AND HEIGHT IN FIELD.

EXISTING WALL MOUNTED RETURN GRILL TO BE REMOVED AND REPLACED.

GC TO PROVIDE TEMPORARY ENCLOSURES FOR RETURN GRILL TO PREVENT INFILTRATION OF DEBRIS DURING ALL ADJACENT SCOPE OF DEMOLITION AND CONSTRUCTION

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> 150 PARK AVENUE PATERSON, NJ 0750 BLOCK: 4101 LOT: 6

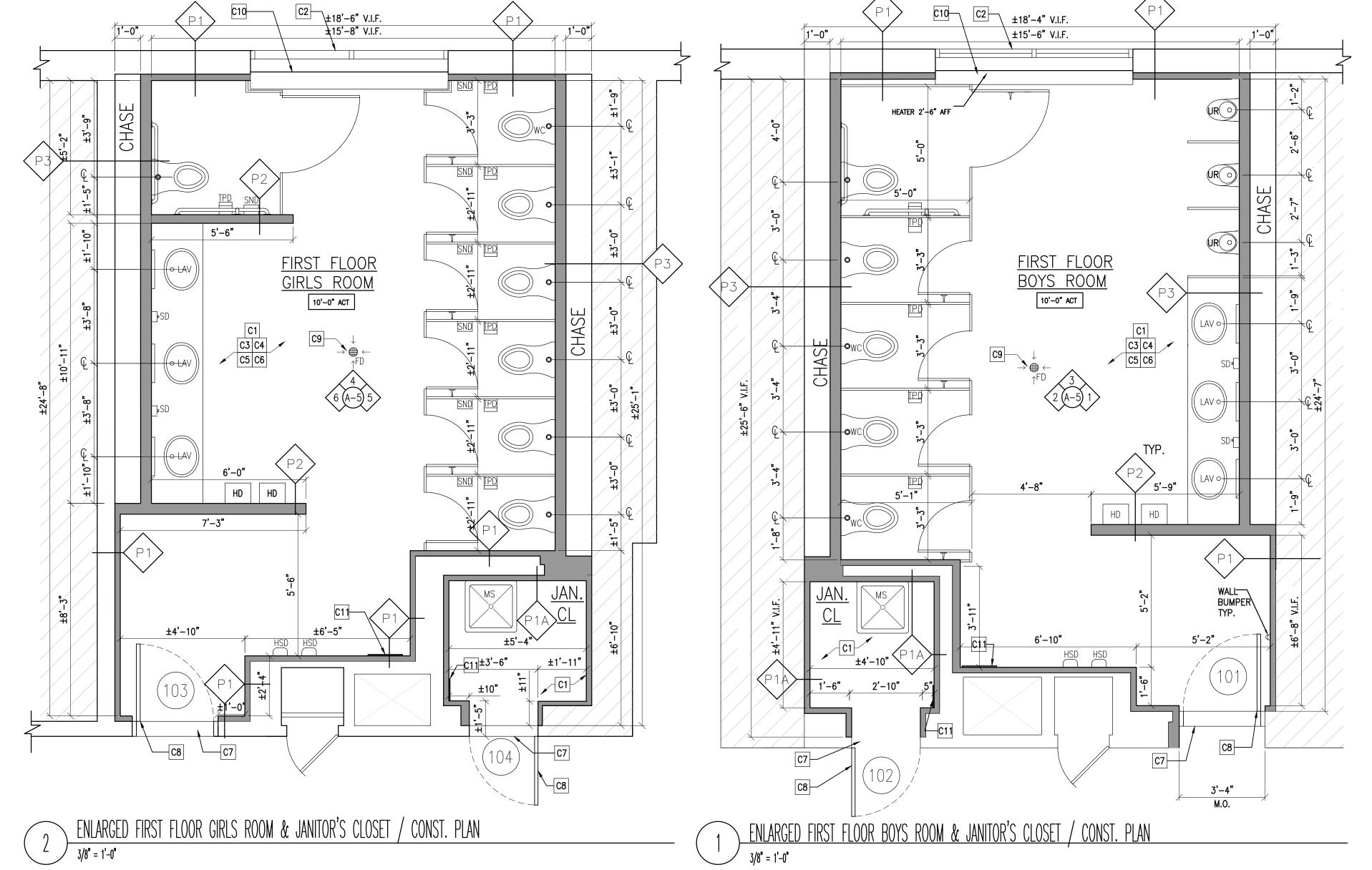
FIRST AND SECOND FLOOR GIRLS & BOYS ERENOVATIONS FOR:
EASTSIDE HIGH SCHOOL

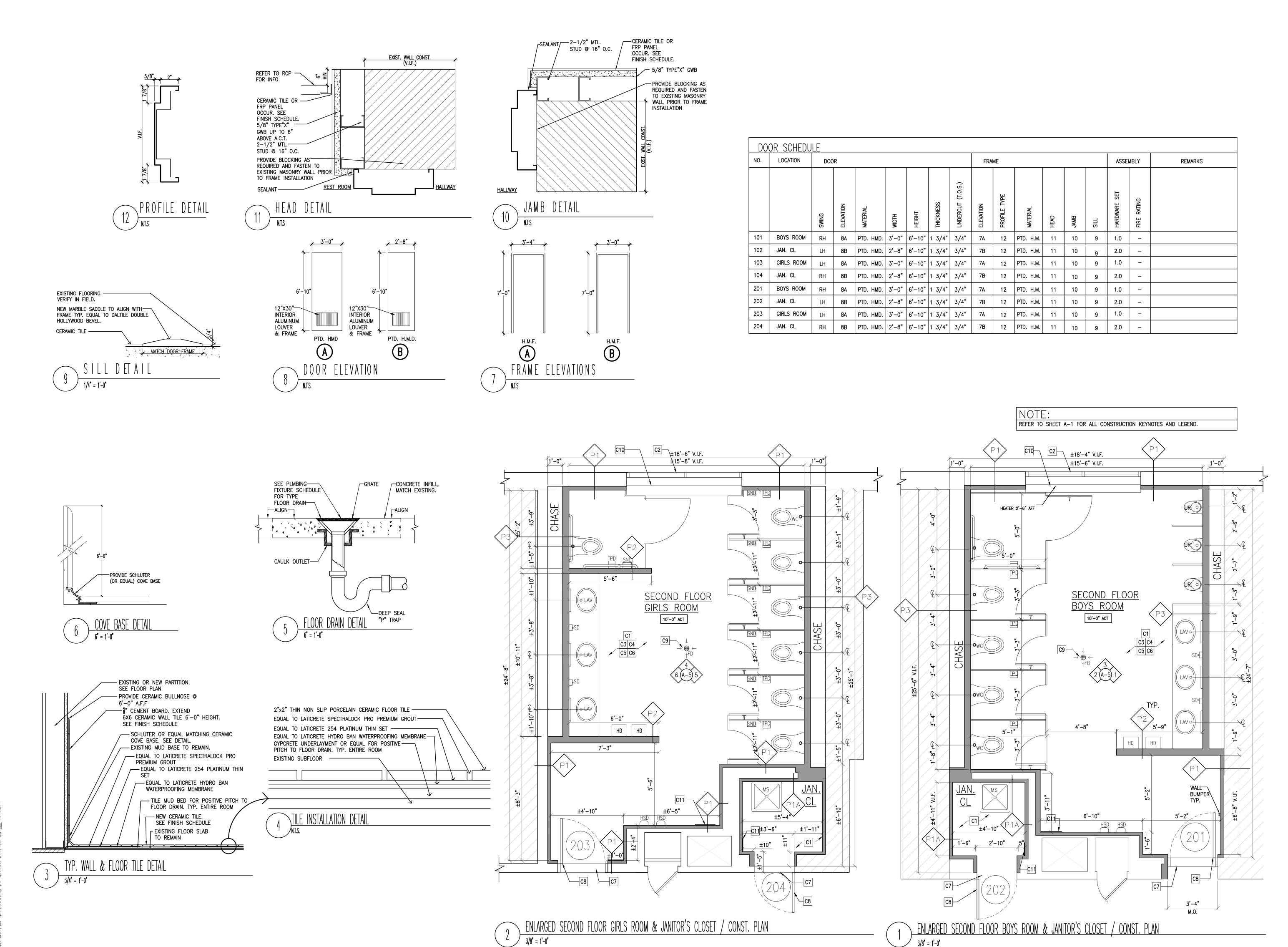
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REVISION

ENLARGED FIRST FLOOR
GIRLS & BOYS BATHROOM
CONSTRUCTION PLANS,
PARTITION SCHEDULE,
FINISH SCHEDULE & DETAIL

AS NOTED
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2025/02/07





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NJ-RA: AI-15992

150 PARK AVENUE
PATERSON, NJ 07501
BLOCK: 4101 LOT: 6 & BOYS BATHROOM

GIRLS 70 FIRST AND SECOND FLOO RENOVATIONS FOR: EASTSIDE HIGH SCHO

اھ

ENLARGED SECOND FLOOR GIRLS & BOYS BATHROOM CONSTRUCTION PLANS,

DOOR SCHEDULE & DETAILS AS NOTED

2025/02/07

24072

DIFFUSERS AND SUPPLY AND EXHAUST REGISTERS C. COORDINATION OF CEILING WORK WITH AIR DEVICES. D. COORDINATION OF OTHER TRADES

F. DUCTWORK INSULATION AND SOUND LINING

E. SPARE FILTERS

G. SHOP DRAWINGS AND EQUIPMENT CUTS H. PERMITS, CERTIFICATES, INSPECTIONS AND **APPROVALS** I. ALL WORK SHALL BE DONE IN ACCORDANCE WITH ALL STATE AND LOCAL CODES, SPECIFICALLY THE INTERNATIONAL BUILDING CODE. THE INTERNATIONAL MECHANICAL CODE, AND THE ASHRAE ENERGY CODE, 90.1, ALL THE EDITIONS ADOPTED INTO LAW BY THE UNIFORM CONSTRUCTION CODE STATE OF NEW JERSEY

IN ADDITION TO ANY REQUIREMENTS OF THE LOCAL

BUILDING AUTHORITY. 1. ALL SHEETMETAL DUCTWORK SHALL BE C-90 GALVANIZED SHEET STEEL WITH SAME MATERIAL HANGERS

CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH THE SMACNA MANUAL FOR LOW VELOCITY DUCT SYSTEMS. USE OF FLEXIBLE DUCTWORK SHALL BE REQUIRED BUT LIMITED TO MAXIMUM OF FIVE-FOOT LENGTHS FOR FINAL CONNECTIONS TO DIFFUSERS

2. ALL DUCTWORK SHALL BE SEALED TO ACHIEVE LEAKAGE RATES SPECIFIED IN SMACNA. SEALANT SHALL BE HARDCAST TYPE ALUMA-GRIP 701 AND MEET 25/50 SMOKE AND FIRE RATINGS. 3. ALL DUCTWORK SHOWN ON THE DRAWINGS IS DIAGRAMMATIC. ALL DUCT RUNS ARE EXPECTED TO BE COORDINATED WITH OTHER TRADES AND BUILDING INTERFERENCE.

4. CONTRACTOR SHALL PROVIDE SHOP DRAWINGS TO SCALE, 1/4 INCH MINIMUM, OF ALL DUCTWORK SHOWING DUCT IN DOUBLE LINE FASHION WITH ALL ELEVATIONS, DIMENSIONS AND AIR DEVICES AND SUBMIT FOR APPROVAL TO OWNER OR HIS AGENT FOR APPROVAL.

ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE, LATEST EDITION APPROVED INTO LAW BY THE STATE OF NEW JERSEY AND ALL SPECIAL REQUIREMENTS OF THE LOCAL AUTHORITY IN ADDITION TO REQUIREMENTS OF THE LOCAL UTILITY COMPANY PROVIDING

2. THE SCOPE OF WORK SHALL INCLUDE, BUT ARE NOT LIMITED TO THE FOLLOWING: 2.1 PROVIDE ALL CONDUIT, WIRING, SWITCHES.

> BALLASTS, LENSES, DIMMERS AND LAMPING TO SUPPLY POWER TO ALL LIGHTING FIXTURES SHOWN 6. ALL ELECTRICAL WORK TO BE PERFORMED IS THE ON THE DRAWINGS 2.2 WIRING AND CONDUIT INSTALLATION FOR HAND

DRYERS 2.3 WIRE AND CABLE AND IDENTIFICATION OF SAME 2.4 TESTING OF ALL DEVICES 2.5 COORDINATION WITH OTHER TRADES

2.6 PERMITS AND FEES . MATERIALS PROVIDED UNDER THESE SPECIFICATIONS SHALL CONFORM TO THE STANDARDS AND BE LISTED BY THE UNDERWRITERS LABORATORIES (UL).

4. MINIMUM SIZES FOR LIGHTING SHALL BE NO. 12 AWG AND BE MANUFACTURED BY AMERICAN INSULATED WIRE, GENERAL CABLE CORP. SOUTHWIRE, TRIANGLE/PWC, OR

OKONITE. SWITCHES SHALL BE OF THE QUIET OPERATING INDICATING TYPE WITH SCREW TERMINALS FOR SIDE AND BACK WIRING RATED 120/277 VOLTS AC, 20 AMP MINIMUM OR AS REQUIRED FOR LOAD PER CODE. TOGGLE ACTION SWITCHES SHALL BE ARROW-HART NO. 1991, 1992, 1993. 1994 OR EQUAL BY HUBBELL.

RESPONSIBILITY OF THE GENERAL CONTRACTOR. POWER WILL BE AVAILABLE IN THE EXISTING ELECTRICAL PANELS LOCATED IN THE CORRIDOR ADJACENT TO THE EXISTING BATHROOMS. GC IS REQUIRED TO PROVIDE ALL CONDUIT, CIRCUITS, WIRING, ETC. AS REQUIRED FOR HAND DRYER INSTALLATION AND ANY OTHER ELECTRICAL REQUIREMENTS IDENTIFIED IN THE CONTRACT DOCUMENTS. COORDINATE VOLTAGE AND ALL OTHER ELECTRICAL REQUIREMENTS WITH HAND DRYERS SUPPLIED BY PCTI.

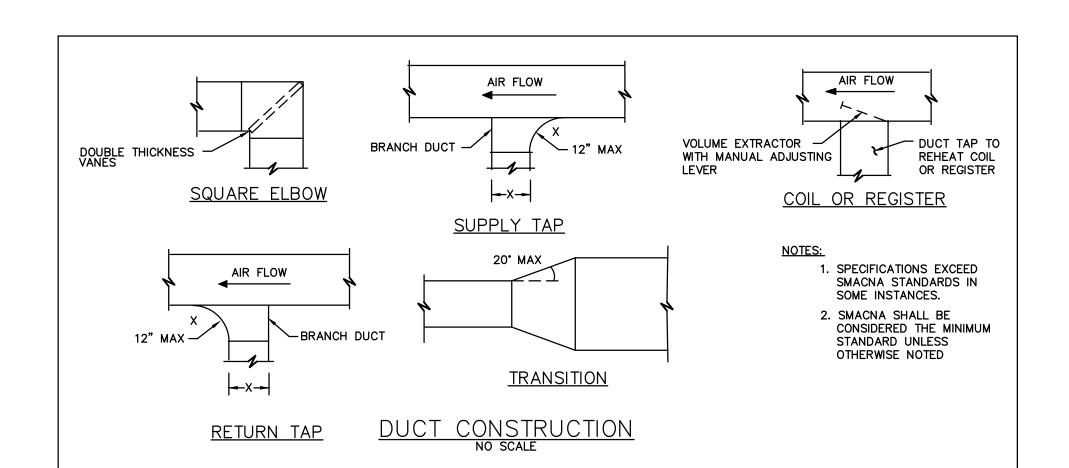
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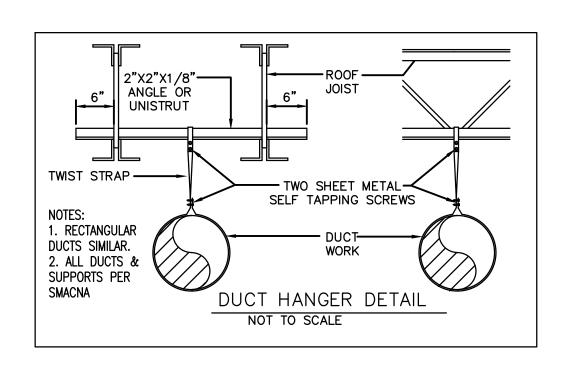
	LATIAUST TAIN SUTTLUULL										
MARK	AREA SERVED	BASIS OF DESIGN		CFM	ESP	RPM	MOTOR HP	VOLTAGE	SONES	WEIGHT	NOTES
IVIAINN		MANUF.	MODEL	1 CFM	LSF	I I I I I I	WICTOR FIF	VOLIAGE	JUNES	WEIGHT	NOTES
EF-1	RENOVATED BATHROOMS	COOK	DB-9	900	0.50	951	3/4 HP	115/1/60	6.5	70 #	1,2

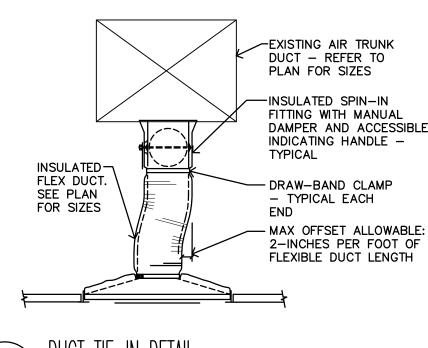
1. INSTALL IN ACCORDANCE WITH MANUFACTURERS WRITTEN INSTRUCTIONS. COORDINATE INSTALLATION WITH ALL TRADES 2. PROVIDE COMPLETE WITH ROOF CURB 14" HIGH, BACKDRAFT DAMPER, BIRDSCREEN, DISCONNECT SWITCH, JUNCTION BOX MOUNTED AND WIRED

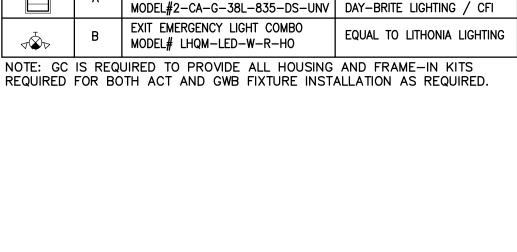
EXH	EXHAUST GRILL SCHEDULE									
MARK	CFM	BASIS OF	DESIGN	TYPE	MOUNTING	NECK SIZE(IN) MODULE NOTE	NOTES			
		MANUF.	MODEL		TYPE					
EG-1	200	TITUS	350RL	RETURN GRILLE	LAY-IN	VARIES	6" X 6"	1,2		
EG-2	100	TITUS	350RL	RETURN GRILLE	LAY-IN	VARIES	6" X 6"	1,2		

1. INSTALL IN ACCORDANCE WITH MANUFACTURERS WRITTEN INSTRUCTIONS. COORDINATE INSTALLATION WITH ALL TRADES 2. INSTALL WITH FACTORY INSTALLED OPPOSED BLADE DAMPER





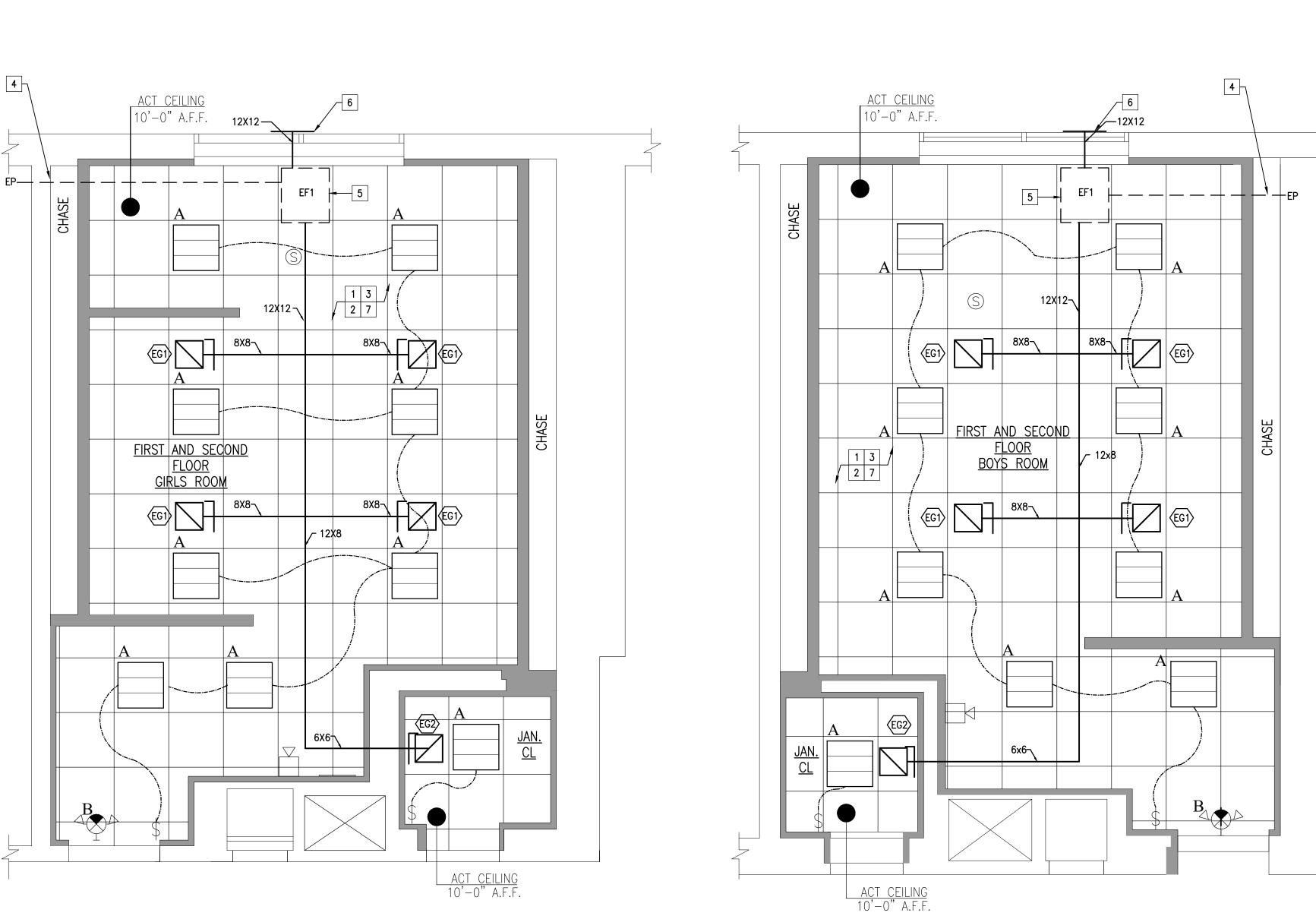












RCP GENERAL NOTES

FOR LIGHTING FIXTURE TO TURN ON.

PANEL (H2)

1. NEW ACT CEILING TO BE SELECTED EQUAL TO ARMSTRONG 2X2 GRID.

2. TYPICAL FOR ALL LIGHTING CONTROLS, LIGHTING CIRCUIT CONSISTS OF

NEW ALUM. CEILING

DIFFUSER. DRAWING

SPECIFICATIONS FOR

FOR SIZES AND

REQUIREMENTS

NEW 2X2 ACT

SEE DRAWINGS

EXISTING SWITCH TO BE

REPLACED WITH NEW

WITH OCCUPANCY

NEW LIGHT FIXTURE

EXISTING CIRCUITING & SWITCHING.

WIRING TIE INTO

TYP.

CEILING.

SENSOR.

VOLUME TAMPER,

COMBINATION LIGHT SWITCH AND OCCUPANCY SENSOR. LIGHT SWITCH HAS TO BE

ON AND OCCUPANCY SENSOR HAS TO DETECT MOVEMENT/OCCUPANCY IN ORDER

3. USE EXISTING LIGHTING CIRCUITS FOR NEW LIGHTING FIXTURES. CONTRACTOR TO

FURNISH AND INSTALL 2#12 AWG, 1#12 AWG GND IN 37 FROM NEW EXHAUST FAN.

5. APPROXIMATE. ROUTING OF ±100" LINEAR FEET OF NEW CONDUIT FROM ELECTRIC

REFLECTED CEILING PLAN SYMBOL LEGEND

EXISTING SMOKE

DETECTOR TO BE

REPLACED WITH

NEW & TIED INTO

EXISTING SYSTEM.

EXISTING HORN

STROBE TO BE

REPLACED WITH

NEW & TIED INTO

VERIFY WITH OWNER

PRIOR INSTALLATION.

NEW EXHAUST FAN

SYSTEM &

DUCTWORK

EXISTING SYSTEM.

VERIFY WITH OWNER

PRIOR INSTALLATION.

ENLARGED FIRST AND SECOND FLOOR GIRLS ROOM & JANITOR'S CLOSET RCP/HVAC PLAN

RCP/HVAC KEY NOTES

NEW CONTINUOUS 2x2 A.C.T. CEILING & GRID, TILES TYPICAL THROUGHOUT. VERIFY IN FIELD PRIOR TO INSTALLATION.

EXISTING SMOKE DETECTORS TO BE RELOCATED. AND RECONNECTED 2 TO EXISTING SYSTEM.

PROVIDE AND REWIRE SWITCHES FOR NEW 2X2 LED LIGHT FIXTURES. TIE INTO EXISTING CIRCUITING AS PER THE LUMINARIES SCHEDULE. REFER TO THE REFLECTED CEILING PLAN (RCP) FOR ADDITIONAL DETAILS.

TIE INTO NEAREST ELECTRICAL PANEL INCLUDE ±100 LINEAR FEET OF NEW CONDUIT. COORDINATE AND VERIFY IN FIELD BEFORE THE INSTALLATION.

NEW EXHAUST FAN SYSTEM & DUCT WORK TO BE INSTALLED. COORDINATE AND VERIFY IN FIELD BEFORE THE INSTALLATION.

REMOVE EXISTING TRANSOM PANEL IN EXISTING WINDOW ABOVE 6 CEILING. REPLACE WITH INSULATED PANEL WITH INTEGRATED 12X12 LOUVRE & BIRD SCREEN. VERIFY EXACT CONDITION IN FIELD PRIOR TO REMOVAL AND REPLACEMENT. PROVIDE FLASHING AND SELANT AS REQUIRED.

VERIFY EXISTING FIRE ALARM CONNECTION & CAREFULLY REINSTALL EXISTING FIRE ALARM SMOKE & HORN STROBE DEVICES.

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□ S.M. COPPA, AIA

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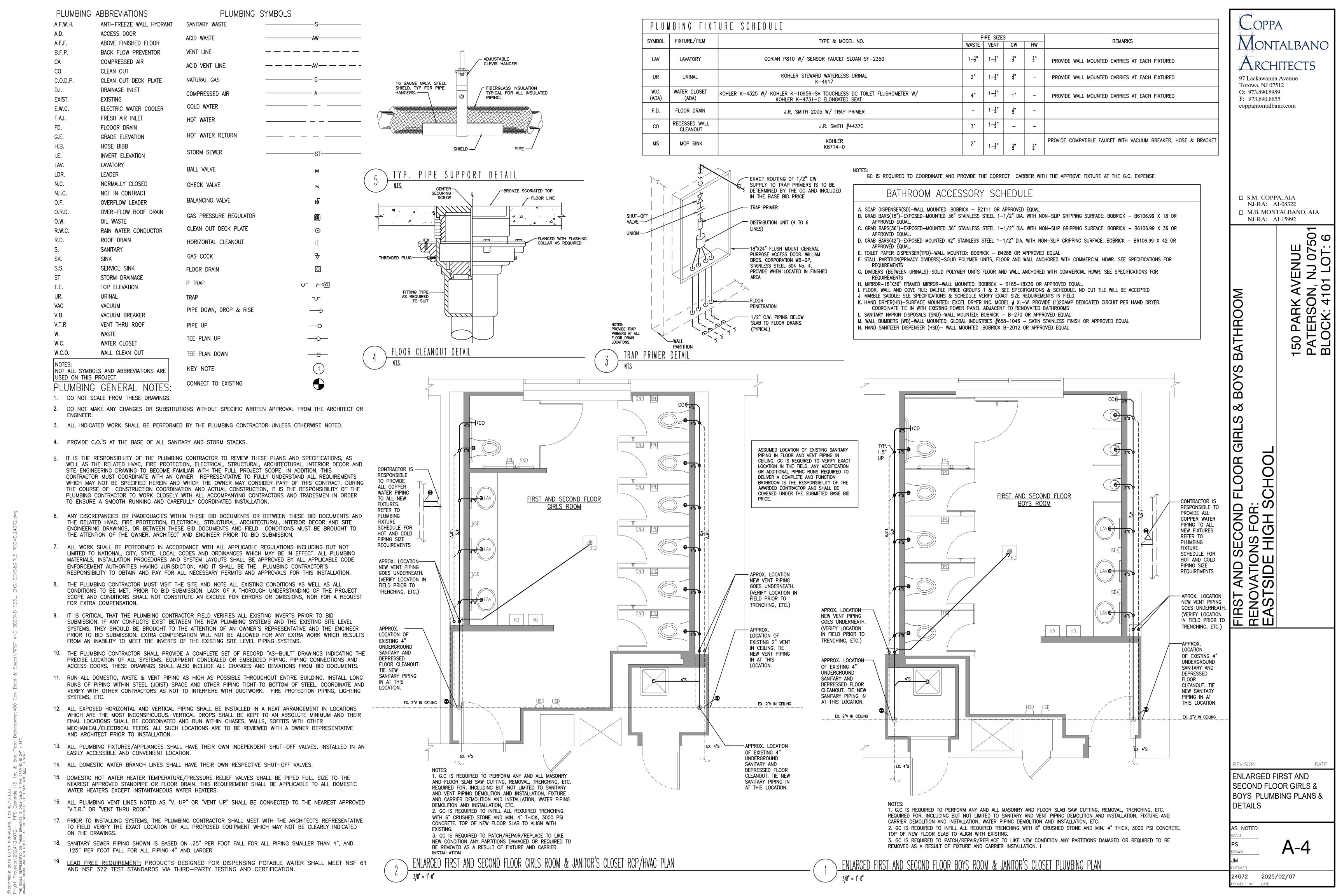
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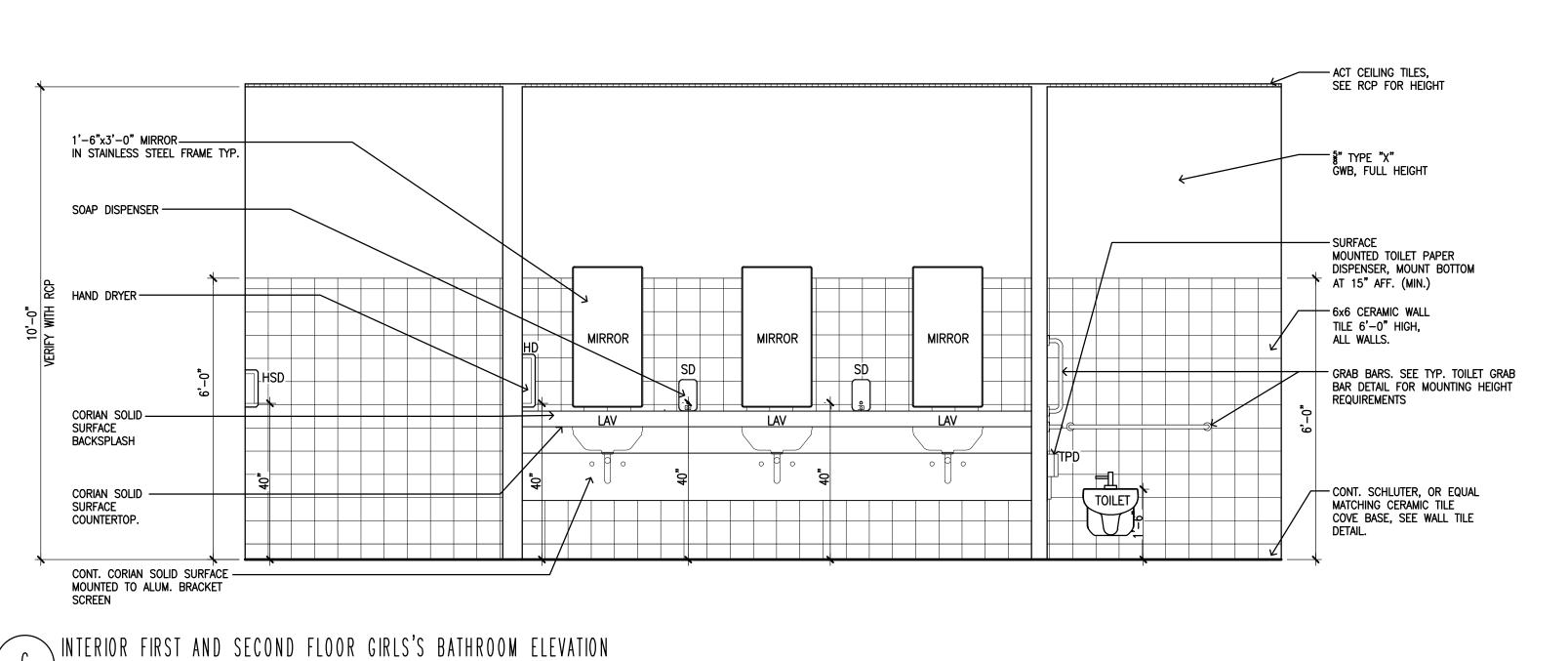
 \mathbf{m} GIRI 0 FIRST AND SECOND FLOOR RENOVATIONS FOR: EASTSIDE HIGH SCHOO

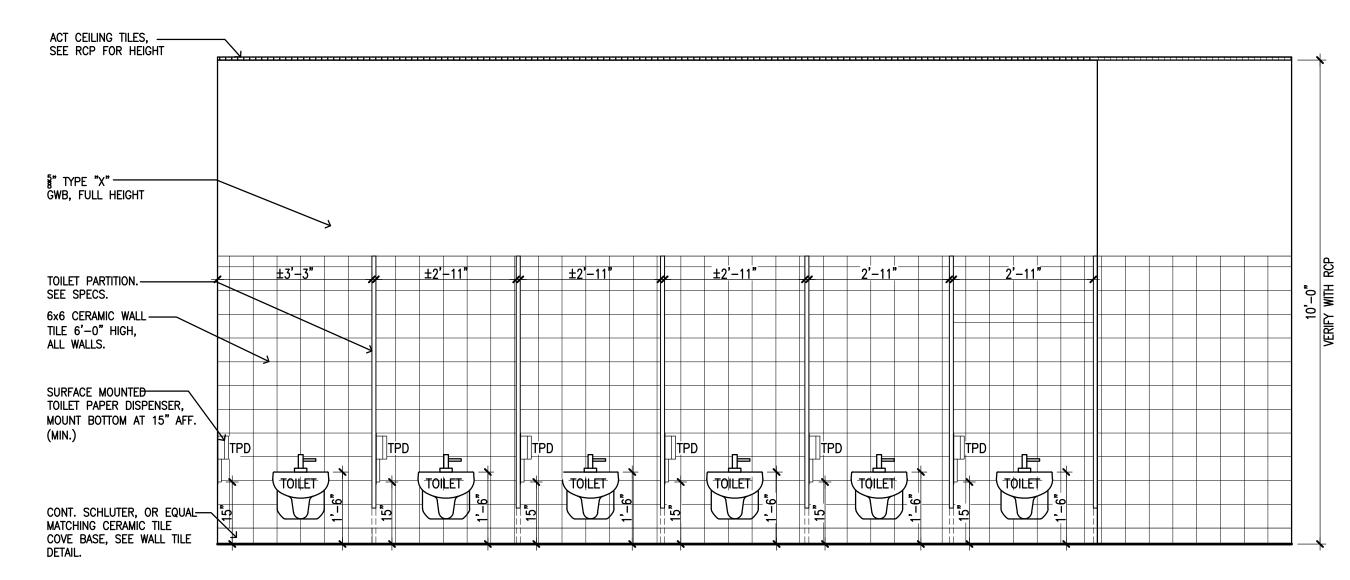
ENLARGED FIRST AND SECOND FLOOR GIRLS & BOYS BATHROOM RCP HVAC PLAN & DETAILS

AS NOTED 2025/02/07

ENLARGED FIRST AND SECOND FLOOR BOYS ROOM & JANITOR'S CLOSET RCP/HVAC PLAN







- ACT CEILING TILES, SEE RCP FOR HEIGHT

TYPE "X"
GWB, FULL HEIGHT

- EXISTING WINDOW @ 5'-0" AFF, P.I.P.

-6x6 CERAMIC WALL

PERFORATED METAL
COVERS FOR EXISTING

LENGTH AND HEIGHT IN

TYP. @ ±2'-6" A.F.F

CONT. SCHLUTER, OR EQUAL MATCHING CERAMIC TILE COVE BASE, SEE WALL TILE

RADIATORS. VERIFY

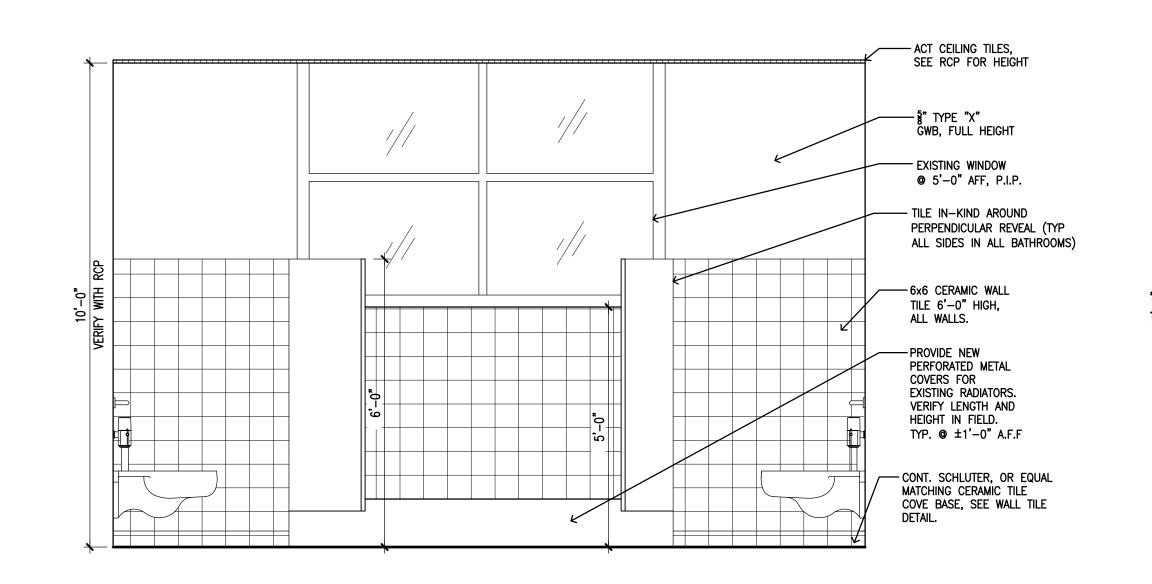
TILE 6'-0" HIGH,

ALL WALLS.

- TILE IN-KIND AROUND

PERPENDICULAR REVEAL (TYP ALL SIDES IN ALL BATHROOMS)

INTERIOR FIRST AND SECOND FLOOR GIRLS'S BATHROOM ELEVATION



INTERIOR FIRST AND SECOND FLOOR GIRLS'S BATHROOM ELEVATION

INTERIOR FIRST AND SECOND FLOOR BOY'S BATHROOM ELEVATION

§" TYPE "X" ——— GWB, FULL HEIGHT

URINAL SCREEN.

CONT. S.S. WALL-

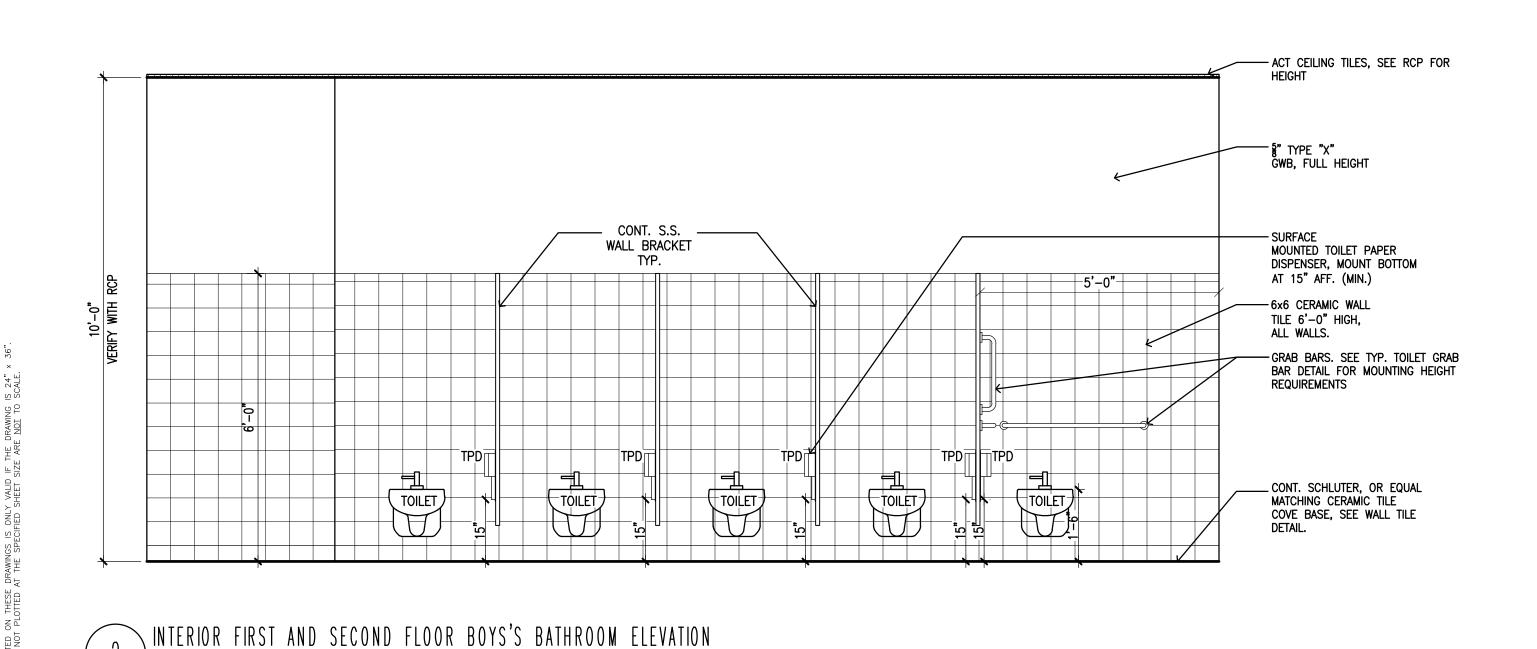
6x6 CERAMIC WALL -TILE 6'-0" HIGH, ALL WALLS.

CONT. SCHLUTER, OR EQUAL-MATCHING CERAMIC TILE COVE BASE, SEE WALL TILE DETAIL.

≨ URINAL

BRACKET TYP.

응 SEE SPECS.



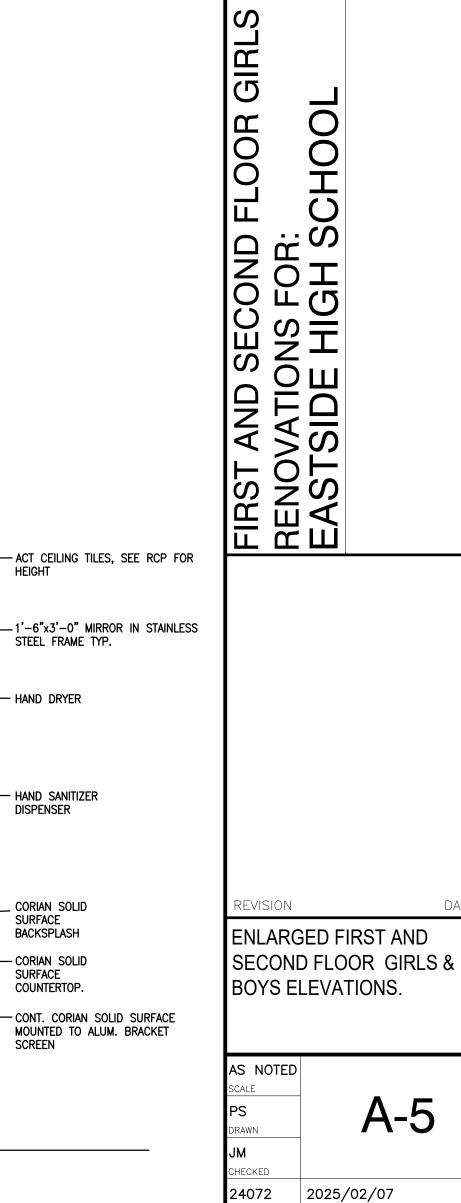
INTERIOR FIRST AND SECOND FLOOR BOYS'S BATHROOM ELEVATION

MIRROR

MIRROR

LAV LAV LAV

MIRROR



HEIGHT

- HAND DRYER

DISPENSER

CORIAN SOLID

BACKSPLASH

- CORIAN SOLID

COUNTERTOP.

SURFACE

SCREEN

Montalbano

ARCHITECTS .

97 Lackawanna Avenue

coppamontalbano.com

☐ S.M. COPPA, AIA

BOYS BATHROOM

NJ-RA: AI-08322

NJ-RA: AI-15992

☐ M.B. MONTALBANO, AIA

50.

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