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INVITATION FOR BID – CONSTRUCTION SERVICES

PROJECT: LCCC Albany County Campus (ACC) Classroom Addition

BID No.: IFB-19060

DUE DATE & TIME: November 28, 2018 @ 3:00 p.m. (prevailing local time)

BID: Sealed Bids, subject to the terms, conditions and specifications herein stipulated and/or attached hereto, will be received at the Laramie County Community College Contracts Office located in the Administration Building on 1400 East College Drive, Cheyenne, WY 82007 at Administration Building room AM-108 in until November 28, 2018 at 3:00 p.m. (prevailing local time), and then publicly opened, read aloud and duly recorded.

PRE-BID MEETING: A MANDATORY Pre-Bid meeting and job walk will be held on November 13, 2018 @ 10:00 a.m. (prevailing local time) at the Albany County Campus (ACC), 1125 Boulder Drive, Laramie, WY 82070 in room 204 Attendance at the Mandatory Pre-Bid meeting is required to bid on this project. ***Doors will be locked at 11:00 a.m.***

Jamie Spezzano
Director, Contracting & Procurement
Laramie County Community College
1400 East College Drive
Cheyenne, WY 82007
Phone: (307) 778-1280
Fax: (307) 778-4300
E-mail: jspezzano@lccc.wy.edu

Document Issue Date: October 18, 2018
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SECTION ONE

DEFINITIONS AND TERMINOLOGY

Wherever used in this bid these or other related procurement documents, the following terms have meanings indicated which are applicable to both the singular and plural thereof.

Addenda: Written or graphic instruments issued prior to the opening of bids which clarify, correct, or change the bid documents or the related procurement documents.

Architect: Owner’s contract consultant and contracted project representative.

Bid and/or Bid Documents: Bid Document, applicable addenda, other affiliated or referenced data specific to said bid.

Bid Process or Period: Begins with issue/publication of bid document to public sector, and concludes at the award of the bid.

Bidder: Vendor, firm, or contractor submitting a Bid

Contractor: Vendor, firm, or company awarded a contract or PO for this Bid

Contract Document: A legally enforceable (binding) agreement between two competent parties; evidenced by an offer and acceptance of offer. Document shall include by reference, all Bid Documents, contractor’s bid, negotiated documents, issued addendums, special or supplemental conditions, specifications, and any mutually agreed upon modifications, and/or additions.

Firm: Same as vendor or contractor

Issuing Office: The issuing office for this IFB is: Tobin & Associates, P.C., 1820 Dillon Avenue, Cheyenne, WY 820091

LCCC: Laramie County Community College (College) or Owner, one in the same.

Purchase Order: A contractual agreement with a vendor for goods or services that specifies payment terms, delivery dates, item identification, quantities, freight terms, and other obligations and conditions.

Specifications: Those portions of this proposal consisting of written or graphic technical descriptions of materials, equipment, construction systems, standards, workmanship, goods, services, and administrative details applicable thereto.

Vendor: Same as company/contractor/firm.

END OF SECTION ONE
SECTION TWO

INSTRUCTIONS TO BIDDERS AND BID REQUIREMENTS

1. GENERAL CONDITIONS

1.1 Notice is hereby given that LCCC will receive sealed bids up to 3:00 p.m. (prevailing local time), November 28, 2018, at that time to be publicly opened and recorded in the Administration Building AM-108, for the LCCC project in accordance with the requirements, terms, specifications, conditions, and provisions hereinafter contained.

1.2 Successful firm shall provide LCCC with the services and/or materials as defined by LCCC Policies and this certain Bid Package.

1.3 Bids must be received by the time and date specified. Bids received after the specified time and date will not be accepted and will be returned unopened to the respective firm.

1.4 Bids shall be sent to the LCCC Purchasing Office or hand-delivered prior to the Bid Opening in a sealed envelope (or package) marked “Sealed Bid”, and referencing the Bid # IFB-19060.

1.5 All bids shall be submitted on the LCCC “BID SUBMITTAL & PRICING DOCUMENT” and must be signed by an authorized official of the firm submitting the Bid.

1.6 Telephone, telegraph, or fax bids will not be accepted.

1.7 Any bid which modifies, deletes, or changes any of the conditions or provisions, specifications, or bid requirements will be rejected. Do not deface or alter any portion of the original Bid package.

1.8 By submitting this bid, each firm certifies under penalty of perjury that they have not acted in collusion with any other firm or potential firms. Neither the said bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other bidder, firm or person to submit a collusive or sham bid in connection with the contract of which the attached bid has been submitted or to refrain from bidding in connection with such contract, or has in any manner, directly or indirectly, sought by agreement, collusion, communication or conference with any other bidder, firm or person to fix the price or prices in the attach bid or of any other bidder; to fix any overhead, profit, or cost element of the bid price or the bid price of any other bidder; or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against the owner or any person interested in the proposed contract.
2. PREPARATION OF BID

2.1 Firms are expected to examine all Drawings, Specifications, instructions and/or requirements of this Bid package. Failure to do so will be at the bidder’s risk. The Bid and all referenced documents must be used in preparation of each bid. LCCC assumes no responsibility for errors, misinterpretations and/or verbal communication resulting from the use of incomplete Bid Documents.

2.2 Each firm shall furnish the information required by the Bid. The BID SUBMITTAL & PRICING DOCUMENT (see SECTION THREE) shall be completed, signed, and returned by the respective firm’s authorized agent. All required bid documents must be returned with the bidder’s sealed bid.

2.3 Time, if stated as a number of days, will be in calendar days.

2.4 Any clarification of instructions, terms and conditions, IFB document, or proposal preparation shall be made only by the Director of Contracting & Procurement listed in this Bid document under IFB SECTION TWO, Article 6, Paragraph 6.1. Verbal clarifications will not be binding upon LCCC or their Architect. Written clarifications will be by addenda and forwarded to all interested parties.

2.5 Written addenda will be issued by LCCC for any matters regarding submittal of Bid, or issues, questions, comments, and/or clarifications that will affect, alter, modify, or change the original Bid intent or language.

2.6 To ensure uniformity and consistency, strict rules will apply to the communication process and methods during the bid process, all inquiries shall be via written instrument, mailed, faxed or hand-delivered to the appropriate individual as detailed in IFB SECTION TWO, Article 6 Paragraph 6.1. All matters, issues, questions, answers, comments and/or clarifications which meet the criteria identified above in Paragraph 2.5 will be distributed in written format to all potential bidders.

2.7 Each erasure, marking, or other changes that appear on your Bid must be initialed individually by the person signing the Bid.

2.8 Any violation of Bid requirements shall be just cause for rejection of that particular bid without further consideration.

2.9 In the case of error in the extension of prices in the Bid, the unit price will govern. In case of discrepancy in the price between the written and numerical amounts, the written amount will govern.

2.10 All Bid prices shall be quoted F.O.B Destination (Cheyenne WY) with transportation payment terms prepaid and allowed.
3. PRE-BID MEETING, SITE INSPECTION AND BID DOCUMENTS

3.1 Prior to submitting bids, vendors are welcome to visit the campus to inform themselves thoroughly as to the conditions involved in providing the materials required by this Bid. Arrangements for such tours should be coordinated thru the Contracts Office.

3.2 A MANDATORY pre-bid meeting and job-walk will commence on November 13, 2018 @ exactly 10:00 am (prevailing local time); **doors will be locked at 11:00 a.m.** The meeting will be held at the Albany County Campus, 1125 Boulder Dr., Laramie, WY 82070 in room 204. All potential bidders shall be present and signed in prior to the start of the mandatory Pre-Bid meeting. Once everyone has signed, the sign-in sheet will be taken and the meeting will “officially” start. Anyone not signed in at the “official” start of the meeting will be considered late and will not be allowed to bid on the project.

3.3 LCCC and Architect’s personnel will be present at the pre-Bid meeting to receive questions with respect to interpretation or clarification of this Bid. Any other request(s) by vendors for interpretation or clarification shall be in writing and shall be addressed to the office of the Director of Contracting and Procurement. The receipt of any request and/or corresponding reply will not alter the bid and bid due date. All requests for interpretations of Bid Documents and other questions received at the pre-Bid will be taken with the formal response through an Addendum and be issued to all plan holders.

3.4 Complete sets of the Bid Documents will be available at no charge via pdf format and may be obtained by going to the LCCC website [https://lccc.wy.edu/about/purchasing](https://lccc.wy.edu/about/purchasing).

3.5 Complete sets of the Bid Documents must be used in preparing bids, neither LCCC or Architect assumes any responsibility for errors or misinterpretations from the use of incomplete sets of Bid Documents.

3.6 LCCC and Architect in making copies of Bid Documents available on the above terms do so only for the purpose of obtaining bids for the work and/or services specified herein, and do not confer a license or grant for any other use.

4. SUBMISSION / WITHDRAWALS / LATE BIDS / MODIFICATIONS

4.1 Prospective vendors are instructed to send or deliver their sealed Bids complete with required "BID SUBMITTAL & PRICING DOCUMENT", attachments, and addenda, enclosed in one sealed and secure box, envelope, or other package, in a manner that assures receipt by **November 28, 2018 at 3:00 p.m. (prevailing local time)**. Package must be sealed, secured and marked in a prominent manner. A public opening and recording of each received bid will be conducted at this date and time. The Bid opening is a public meeting, open to anyone interested in attending.
4.2 Bids may be withdrawn or amended at any time prior to Bid due date. All such requests must be done via written instrument.

4.3 A Bid that is in the possession of the LCCC Contracts Office may be altered by a telegram, fax, or letter bearing the signature of the official authorizing the Bid, provided that it is received prior to the bid due date and time. Telephone or verbal alterations of a Bid will not be accepted.

4.4 Formal, advertised Bids indicate a date and time by which Bids must be received, Bids received after that time will be returned, unopened to the vendor.

4.5 Each firm submitting a bid agrees that their Bid shall remain valid for a minimum of thirty (30) calendar days from the date of closing of this Bid.

5. CERTIFICATE OF NON-DISCRIMINATION

5.1 The bidder hereby certifies that all persons employed by their firm, their affiliates, subsidiaries, or holding companies are treated equally by their firm without regard to or because of race, religion, ancestry, national origin or sex as required by federal and state anti-discrimination laws. The bidder further certifies and agrees that it will deal with subcontractors, bidders or vendors without regard to or because of race, religion, ancestry, national origin or sex. Violation of this certification may constitute a material breach of contract upon which the owner may determine to cancel, terminate, or suspend the contract.

6. QUESTIONS CONCERNING BID

6.1 All inquiries, matters, issues, questions, answers, comments, and/or clarifications concerning this Bid shall be directed to the following individual, and shall be done so via written instrument, mailed, faxed or hand-delivered to:

6.1.1 For matters pertaining to this Bid Document, contact;
- Jamie Spezzano, Director, Contracting & Procurement
- 1400 East College Drive
- Cheyenne, WY 82007
- Phone: (307) 778-1280
- Fax: (307) 778-4300
- E-mail: jspezzano@lccc.wy.edu

6.1.2 All matters, issues, questions, answers, comments, and/or clarifications concerning this Bid shall be submitted no later than November 20, 2018 at 5:00 p.m. MST and may be e-mailed.

6.2 All matters, issues, questions, answers, comments, and/or clarifications that alter, modify, or change the original Bid intent or language will be addressed formally via a written Bid Addenda.
Information gathered by bidders through verbal conversations, phone conversations, e-mails and fax transmittals will NOT be considered formal information and should NOT be used for Bid preparation.

6.3 All issued Addenda must be acknowledged by each respective firm submitting a Bid on the document located in IFB SECTION THREE, titled Addenda Acknowledgement Document.

7. **CONTRACT CONDITIONS**

7.1 The scope of work and/or services shall commence upon signing of a Contract.

7.2 The vendor who is awarded a Contract is prohibited from sub-contracting, assigning, transferring, or otherwise disposing of the agreement or its’ rights, title or interest therein to any other party without the prior written consent of the Vice President of Administration and Finance Services or the Director of Contracting and Procurement, or their designated representative. All approved assignments or other transfers referred to herein must abide by the provisions of the Contract.

7.3 LCCC will execute the contract incorporating all of the specifications, requirements, terms, conditions, and provisions included in the Bid and any additional documents or data provided by LCCC or the successful firm and are deemed relevant for inclusion by LCCC.

7.4 The successful firm will be expected to properly and promptly execute this Contract. Failure to do so could result in cancellation of this Bid award to the recommended vendor. Should this happen, the Bid process may be started anew, if deemed necessary by LCCC.

8. **INSURANCE REQUIREMENTS**

8.1 Throughout the term of the Contract, the successful firm shall carry and pay the premium for Certificate of Liability Insurance per Exhibit “A”, with such policies of insurance limits satisfactory to LCCC as will protect LCCC; its Board of Trustees, officers, employees, Architect’s, and agents; individually and collectively from Worker’s Compensation claims and from any other claims for damages to property or for bodily injury, including death, which may arise from or in connection with the operations under this Contract, whether such operations be by the successful firm or by any subcontractor firm or anyone directly or indirectly employed by either of them. Such insurance shall cover all contractual obligations which the successful firm has assumed.

8.2 The limits of the insurance coverage(s) listed above shall be in compliance with IFB Document Exhibit “A”

8.3 Prior to the commencement of the Contract, the successful firm shall deliver certificates of insurance evidencing such policy or policies to
the LCCC Director of Contracting & Procurement. These certificates of insurance are to contain the endorsements set forth below.

8.4 **“Hold Harmless” Clause:** [with statement on certificate that these endorsements are included in the policy(ies)]. The successful firm assumes the liability for all losses, damages (including loss of use), expenses, demands and claims in connection with or arising out of any injury or alleged injury to persons (including death) or damages or alleged damage to property, sustained or alleged to have been sustained in connection with or to have arisen out of the performance of the work by the successful firm, the subcontractor firms, and their agents, servants and employees, including losses, expenses, or damages sustained by LCCC. The successful firm hereby undertakes and agrees to indemnify and hold harmless LCCC; its Board of Trustees, officers, employees, Architect’s and agents; individually and collectively, from any and all such losses, expenses, damages (including loss of use), demands and claims, and shall defend any suit or action brought against them, or any of them, based on any such alleged injury (including death) or damage (including loss of use), shall pay all damages, judgments, costs, and expenses, including attorney’s fees in connection with said demands and claims resulting therefrom. However, successful firm does not assume liability for nor indemnify LCCC against any such losses resulting from the sole negligence of LCCC or its employees or agents.

8.5 **“Cancellation” Clause:** The policies of insurance covered by this certificate will not be allowed to expire, be canceled, terminated or materially altered prior to their maturity date unless there shall be given no less than thirty (30) days prior written notice by certified or registered mail to LCCC’s Director of Contracting & Procurement.

8.6 **“Additional Insured” Clause:** LCCC shall be listed as an additional named insured on all policies, but only with respect to operations of successful firm under the Contract.

8.7 The procuring of the insurance required under the Contract shall not relieve the successful firm of any obligation or liability assumed under this Contract, including specifically the Indemnification Agreement that follows below in Paragraph 8.8. The successful firm may carry at own expense such additional insurance as it may deem necessary. The successful firm shall assist and cooperate in every manner possible in connection with the adjustment of all claims arising out of successful firm’s operations within the scope provided for under the Contract, and shall cooperate with the insurance carrier in all litigated claims and demands, arising from said operations, which the insurance carrier or carriers are called upon to adjust or resist.

8.8 **Indemnification Agreement:** To the extent permitted by law, successful firm shall indemnify and hold harmless LCCC; and its Board of Trustees, officers, employees, Architect’s and agents; individually and collectively, from any and all losses, damages (including loss of use), expenses, demands and claims in connection with or arising out of
any injury or alleged injury to persons \textit{(including death)} or damage or alleged damage to property, sustained or alleged to have been sustained in connection with or to have arisen out of the performance of the work by the successful firm, the subcontractor firms, and their agents, servants, and employees, including losses, expenses, or damages sustained by LCCC. The successful firm shall defend any suit or action brought against them, or any of them, based on any such alleged injury \textit{(including death)} or damage \textit{(including loss of use)}, and shall pay all damages, judgments, costs, and expenses, including attorneys’ fees in connection with said demands and claims resulting therefrom.

8.9 In the event that the successful firm shall fail to maintain and keep in force Comprehensive General Bodily Injury and Property Damage Liability Insurance, Workers’ Compensation Coverage, and other insurance coverage’s, as hereinabove provided, LCCC shall have the right to cancel and terminate the Contract forthwith and without notice.

9. **APPLICABLE WYOMING STATE STATUTES**

9.1 LCCC shall apply the following State of Wyoming Statutes to this Bid.

9.1.1 §16-6-101 through 121 titled “Public Property – Public Works and Contracts”.
9.1.2 §16-6-201 through 206 titled “Preference for State Laborers”.
9.1.3 §16-6-701 through 708 titled “Construction Contracts with Public Entities”.
9.1.4 §16-1-1001 titled “Capital Construction Projects Temporary Restrictions”.
9.1.5 §27-4-401 through 413 titled “Prevailing Wages”.
9.1.6 §16-6-901 through 902 titled “Use of Apprenticeship Programs on Public Works Projects”.

9.2 Expenditures or contracts involving federal funds are subject to federal rules and regulations, therefore under these conditions, State of Wyoming preference laws do not apply.

9.3 Final payment will be made subsequent to a forty-one (41) day advertising period, as required by Wyoming Statute §16-6-117. The final payment is also conditioned upon receipt of a sworn affidavit as required by this Statute. Said affidavit shall be completed by Contractor stating that all claims for materials and labor under the contract have been paid in full. Should there be a disputed claim, the affidavit shall so state the exact amount to be withheld from the final payment.

9.4 Acknowledgement and compliance with applicable State Statutes is the sole responsibility of the “Prime” or “General” Contractor and all subcontractors. LCCC reserves the right to request written verification of same.
10. **LAWS AND REGULATIONS**

Successful firm shall comply with all laws, ordinances, and regulations of any applicable federal, state, county, or city government applicable to the performance of the services described herein. LCCC agrees to provide all cooperation reasonably necessary for such compliance. In addition, successful firm shall also comply with all LCCC policies and regulations as may currently and/or in the future pertain to service under the subsequent Contract. These laws, ordinances, regulations, and policies shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though written out in full.

11. **LICENSES, PERMITS AND TAXES**

Contractor shall secure and pay for all federal, state, and local licenses and permits required for the performance of the work and/or services provided for herein. LCCC will cooperate with successful firm in obtaining all licenses and permits and will execute such documents as shall be reasonably necessary or appropriate for such purposes. Successful firm shall pay for any and all taxes and assessments attributable to the performance of the contract work and/or services provided herein including but not limited to sales taxes, excise taxes, payroll taxes, and federal, state, and local income taxes.

12. **QUALIFICATIONS OF CONTRACTOR**

12.1 The contractor quoting on this project may be required submit three (3) letters of reference from persons for whom they have done the type of work described by these specifications within the last three (3) years. In the event that the contractor has performed this type of work for Laramie County Community College within the last three (3) years, no letters of reference are required. In the event that such letters are not available, contractors shall supply the owner’s representative with the names, phone numbers, and addresses of persons or firms for whom they have done this type of work during the last three (3) years.

12.2 Contractor and each of its sub-contractors hereunder, if any, shall at its sole expense, obtain insurance as detailed in Exhibit “A” from reliable insurance companies acceptable to LCCC, with limits specified in U.S. currency or equivalent. Such insurance shall be in force at the time the contract has commenced and shall remain in force for the duration of this contract, unless a later date is specified by LCCC.

12.3 Contractor shall secure and pay for all federal, state or local licenses and/or permits required for this specific scope of work provided for herein.

12.4 The Contractor shall function as an independent contractor for the purposes of this Agreement and shall not be considered an employee of LCCC. It is intended that the fees paid hereunder shall constitute
earnings from self-employment income. The Contractor shall assume sole responsibility for and indemnify LCCC against liability for any debts, liabilities, taxes, duties, fees or fiscal charges that may be incurred by the Contractor in fulfilling the terms of this Agreement. LCCC will not withhold any amounts therefrom as U.S. Federal income tax withholdings from wages or as employee contributions under the U.S. Federal Insurance Contributions Act or make employer contributions thereunder with respect thereto. Contractor shall be solely responsible for the reporting, estimation and payment of all income taxes, fees, and other contributions on or attributable to self-employment income attributable to the fees payable hereunder.

13. **SAFETY AND HEALTH**

13.1 The successful firm shall comply with the Occupational Safety and Health Act (OSHA) of 1970 and the American Disability Act (ADA) of 1992 or the applicable standards promulgated under said Acts.

13.2 The successful firm shall take reasonable and proper care and shall use and maintain LCCC property, facilities and equipment under its care, custody, and control in a manner which shall not cause any violations, abuse, or misuse of said property, facilities, and/or equipment.

13.3 The contractor shall be responsible for implementing safety measures for the protection of their employees and members of the public during all phases of the contract work. The contractor shall be responsible for the supply and placement of traffic safety cones, barricades, warning signs, etc. Work shall be performed in compliance with OSHA regulations and other relevant and applicable codes and regulations.

13.4 If successful firm’s bid requires a capital investment for the performance of this Contract, such capital investment program shall be free of conditions which violate OSHA and ADA or other applicable standards. Should repairs, alterations, modifications, or replacements be required to comply with the cited Acts, such action shall be the responsibility of the successful firm. Should a determination be required as to whether a specific condition violates said Acts, such determination shall be made by a competent safety Architect or safety consultant.

13.5 Should successful firm furnish equipment for the performance of this Bid, such equipment shall be free of conditions which violate OSHA and ADA, or their applicable standards. Should repairs, alterations, modifications, or replacements be required to comply with the cited Acts, such action shall be the responsibility of successful firm.

13.6 The successful firm shall comply with and conform to all applicable fire, and public safety, laws, regulations, ordinances, code requirements, as well as LCCC’s safety regulations.
14. **HAZARDOUS MATERIALS**

14.1 The contractor agrees to indemnify and hold Laramie County Community College harmless for any release of any kind of toxic wastes or hazardous material, or any violation of any law or regulation of the EPA or DEQ that is caused by the contractor or any of the contractor’s subcontractors.

14.2 Contractor shall provide LCCC with a current copy of all applicable Material Safety Data Sheets (MSDS) for each chemical, material, or product used during the performance of this scope of work.

14.3 Contractor is responsible for ensuring that all personnel who handle chemicals, materials, or products (*and their respective wastes*) are knowledgeable and properly trained, and that these chemicals, materials, or products are properly used, applied, handled, stored, transported and disposed of in accordance with federal, state, and local rules, regulations, and/or requirements.

14.4 Contractor shall provide knowledge of proper spill prevention and spill response methods for all chemicals or hazardous materials in use.

14.5 Contractor shall NOT dispose of any hazardous waste on campus. Contractor is responsible for off-site hazardous waste disposal, and any associated costs, fees, or permits associated with such disposal.

15. **RESPONSIBILITIES OF BIDDER**

15.1 The firm awarded the Bid shall comply with all applicable City of Cheyenne WY, Laramie County WY, State of Wyoming, and federal laws, regulation, codes, and standards.

15.2 Each bidder is solely responsible for all costs borne and associated with the preparation and delivery of this Bid, and shall not be reimbursed by LCCC. Said costs may include (*but not limited to*) labor, travel, materials, licenses, administrative expenses, and personal charges.

15.3 It is the responsibility of each firm before submitting a Bid to:
   a) Examine, study, and be familiar with complete Bid and referenced documents.
   b) Visit the LCCC site and become familiar with local and site conditions, if necessary.
   c) Promptly give LCCC written notice of all conflicts, errors, ambiguities, or discrepancies that the bidder discovers in the Bid or its’ related documents.

15.4 Each Bid shall be accompanied by a bid bond, certified check, or cashier’s check in an amount of 5% of the Bid. The bid security shall be drawn upon a surety company with a rating of “A” or better.
according to the Best Publication and licensed in the state of Wyoming. The security shall be made payable without condition to LCCC as a guarantee that if the bid is accepted, the bidder will enter into a contract with LCCC for the work prescribed by said bid. The bid security of all bidders will be retained until the contract is awarded or other disposition has been made. If the successful bidder fails to execute a contract and/or agreement and to furnish other required documentation within ten (10) days of notice of award, LCCC shall be entitled to collect the amount of the bidder’s proposal guarantee and costs of any legal fees incurred for collection of the bid bond or any damages incurred by LCCC as liquidated damages as to award the prescribed bid work by the successful bidder to another bidder or to re-advertise the bid or otherwise dispose of the said bid as LCCC may see fit.

15.5 The successful bidder shall be required as per Wyoming Statute §16-6-112 to provide a contractor’s performance and payment bond or other guarantee in an amount equal to 100% of the contract sum. If the contract sum is one hundred thousand dollars ($100,000.00) or less, other forms of bond or guarantee may be approved by LCCC prior to acceptance of such bond or guarantee. The bonding company must have a rating of “A” or better according to Best Publication.

15.6 Each applicant is solely responsible for any cost incurred prior to issuance of a legally executed contract. No property interest, of any kind or nature, shall accrue until a contract is awarded and signed by all parties.

15.7 Each applicant is solely responsible for any cost incurred prior to issuance of a legally executed contract. No property interest, of any kind or nature, shall accrue until a contract is awarded and signed by all parties.

15.8 **OSHA Training Certification:** For public construction contracts estimated to cost more than $30,000, contractors must certify in the bid or the contract that all employees to be employed at the worksite will have completed a course in construction safety and health that is at least ten hours (10-hour card) in duration and has been approved by the United States Occupational Safety and Health Administration.

16. **TRADE NAME AND SUBSTITUTION PROVISIONS**

16.1 Trade names designated in the specifications are used as an acceptable standard quality. Products of other manufacturers will not be considered unless specifically stated. Substitutes or equals are not acceptable where non-substitution is specified in the Bid Document.

16.2 It is the intent of the Bid Documents that the work be completed in all respects in accordance with the subsequent Contract Documents. **This work is to be bid exactly as specified.** Where details and/or
specifications are incomplete or unclear, the Bidder should request clarification in writing prior to the Bid due date.

17. **BID EVALUATION CRITERIA / AWARD OF BID**

17.1 In evaluating Bids, LCCC personnel will consider whether or not the Bid complies with the prescribed Bid requirements and specifications per the Bid Document.

17.2 Acceptable and responsive Bids will be evaluated per the criteria detailed in the Bid Documents. Any assumptions, exceptions or exclusions related to any part of the Bid Documents may result in a bidder being disqualified or reduced in standing.

17.3 LCCC reserves the right to reject any or all Bids, including without limitation, if they are, in its’ sole discretion judged unacceptable, non-responsive, non-conforming, conditional, to waive any technical or formal defect therein, to accept or reject any part of a Bid, to reject or disapprove of any vendor as may be in the best interests of LCCC.

17.4 Cost **may not** be the sole basis for selection, since it is in LCCC’s best interest to obtain materials and/or services which best meet our needs, specifications, and requirements. In addition to price, the following will be considered in the evaluation of this Bid:

17.4.1 The ability, capacity, and skill of the bidder to perform the service or provide the material required, including the sufficiency of financial resources available.

17.4.2 The character, integrity, reputation, judgment, and experience of the bidder.

17.4.3 The quality and quantity of performance of previous contracts.

17.5 Upon review of the Bids, LCCC reserves the right to request the following additional information:

17.5.1 A break-down of bid costs to a reasonable level of detail.

17.5.2 An accounting review of bidders costs and submitted Bid.

17.5.3 Written Bidder verification of Bid Pricing and Specifications.

17.5.4 Other additional information that may be applicable to the evaluation and award of this Bid.

17.6 The Bid will be awarded to the lowest, most responsive and most responsible bidder complying with the prescribed Bid requirements and specifications, provided the price is reasonable and it is in the best interests of, and most advantageous to LCCC to accept it. The Director of Contracting & Procurement reserves the right to reject any and all bids and to waive any informality in bids received whenever
such rejection or waiver is in the best interest of LCCC. Said individual also reserves the right to reject the Bid of a bidder who has previously failed to perform properly or complete on time or on budget services of a similar nature, or a Bid of a bidder whose investigation shows is not in a position to perform the specified service.

17.7 LCCC reserves the right to negotiate with the successful Bidder any required changes and/or modifications to this Bid prior to signature of a Contract, if deemed in the best interest of LCCC to obtain the objectives and intent of this Bid, including (but not limited to) budget compliance, scope of work modification, additions and/or deletions.

18. OWNERSHIP OF DOCUMENTS / COLLEGE PROPERTY

All drawings, specifications, pictures, data, information, documents, Bid related documents, and subsequent contract and/or PO documents are considered the sole property of LCCC and/or the Consulting Architect, and shall not be transmitted in any fashion or form without the express written consent of the LCCC legal counsel, Vice President of Administration and Finance Services, or their designated representative and the Consulting Architect’s Principal-in-Charge.

19. MATERIAL AVAILABILITY

19.1 It is the responsibility of each bidder to verify the availability of material(s), delivery schedules, fabrication and manufacturing schedules and other pertinent data prior to submission of their Bid; and the responsibility of the successful bidder to provide same after award of the Bid. It is the responsibility of the bidder to notify LCCC immediately if material(s) specified are discontinued, replaced, or not available for an extended period of time. LCCC reserves the right to charge back additional costs, including but not limited to, freight, special handling, and purchase price difference due to delays, etc., to the successful bidder when items are not supplied as bid.

19.2 Failure of a bidder to furnish, within the time specified per the Bid for equipment, supplies, materials, services, and/or other items on which a Bid award is made, shall be cause for removal of bidder from the active list of bidders.

20. PUBLIC INFORMATION

All information, except that classified as confidential and/or proprietary, will become public information at the time that the Bid is awarded in accordance with applicable sections of the federal “Freedom of Information Act (FOIA) and Wyoming State Statute §16-4-201. Confidential and/or proprietary information must be marked “CONFIDENTIAL” and/or “PROPRIETARY” in bold letters in the upper right hand corner of each sheet (page) containing the confidential information. Price and information concerning the Bid specifications cannot be considered confidential. All information identified as confidential and/or proprietary will remain confidential unless LCCC is
required by legal order to make it available to the public or to particular parties.

21. PROTESTS

Any firm or vendor who is allegedly aggrieved in connection with the solicitation of a Bid, or award of a contract may protest. The protest must be submitted in writing to the Director of Contracting & Procurement within five (5) days after notification to all firms of intent to award. If the protest is not resolved by mutual agreement, the Director of Contracting & Procurement will promptly issue a decision in writing to the protestant. If the protestant wished to appeal the decision rendered, such appeal must be made in writing to the LCCC Vice President of Administration and Finance Services. The decision of this VP will be final. Unless this procedure is followed, a protest need not be considered by LCCC.

22. RESPONSIBILITIES OF LCCC

22.1 Execute Notice of Award, Notice to Proceed, Contract and/or Agreement following approval and award to the successful bidder.

22.2 Provide to all bidders any applicable documentation, drawings, specifications, records, or other data required to complete this bid.

22.3 Provide as required, uniform and consistent written documentation to all potential bidders deemed to be support assistance and as necessary to complete a Bid submittal.

22.4 LCCC may conduct such investigations as deemed necessary to establish the responsibility, qualifications, and financial ability of a bidder, their suppliers, affiliates, consultants, and/or sub-contractors to perform the services in accordance with this Bid.

23. PAYMENT SCHEDULE

23.1 LCCC shall make progress payments against the Bid Compensation sum which shall be submitted on an “Application and Certification for Payment (AIA Document G702 or equivalent). Each Application for Payment shall be one (1) calendar month ending on the last day of the respective month.

23.2. Each payment shall include detailed invoices as required by LCCC policies and procedures or other applicable regulations.

23.3 Final payment will be made subsequent to a forty-one (41) day advertising period, as required by Wyoming Statute §16-6-116 and 117. The final payment is also conditioned upon receipt of a sworn affidavit as required by this Statute. Said affidavit shall be completed by Contractor stating that all claims for materials and labor under the contract have been paid in full. Should there be a disputed claim, the affidavit shall so state the exact amount to be withheld from the final payment.

Invitation to Bid No. IFB-19060
Page 17 of 26
24. **TAX EXEMPTION**

LCCC is exempt from Wyoming sales or use tax for direct purchases of materials and supplies. A copy of the Wyoming Sales Tax Exemption Form will be issued upon request. LCCC’s federal identification number is 83-6009473.

**END OF SECTION TWO**
SECTION THREE

BID SUBMITTAL & PRICING DOCUMENT

DO NOT MODIFY BID DOCUMENT – Any modification or alteration to this Document from its original format will result in rejection of the respective Bid. BID FORM TO BE COMPLETED IN ITS ENTIRETY, SIGNED IN INK, AND SUBMITTED IN ITS ENTIRETY.

Bid No.: IFB-19060

Bid Description: LCCC Albany County Campus (ACC) Classroom Addition

Bid Due/Opening Date: November 28, 2018 @ 3:00 p.m. (prevailing local time)

This Bid shall be submitted to:
Laramie County Community College
Admin Building AM-104
1400 East College Drive, Cheyenne, WY 82007

1. BID REQUIREMENTS AND FORMAT

1.1 An original Bid shall be completed on this document titled “BID SUBMITTAL & PRICING DOCUMENT” and submitted per the specifications and requirements of Bid No. IFB-19060. Failure to complete or submit any required portion of this BID SUBMITTAL & PRICING DOCUMENT; and/or to deface or alter any portion of the Bid Documents shall be cause for rejection of said Bid as being unacceptable, non-responsive, non-conforming or conditional.

1.2 The undersigned agrees that their Bid will not be withdrawn for a period of forty-five (45) days from the date of Bid opening.

1.3 The undersigned Bidder proposes and agrees, if this Bid is accepted, to perform all work and/or services as specified or indicated in the Bid Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bid Documents. Bidder acknowledges that they have included the cost of all insurance requirements, permits, bonds and taxes as required, and will execute and return same in the time allotted within the general conditions of the Bid Documents and subsequently issued Contract.
1.4 Bidder has visited the site and become familiar with and is satisfied as to the general, local and site conditions that may affect cost, progress, and performance of the work and/or services. Bidder has correlated the information known to bidder, information and observations from visits to the work site, reports and drawings identified in the Bid Documents.

1.5 Bidder is familiar with and is satisfied as to all federal, state and local laws and regulations that may affect cost, progress and performance of the work and/or services.

1.6 Bidder does not consider that any further examinations, investigations, explorations, tests, studies, specifications, or date are necessary for the determination of this bid for performance of the work and/or services at the price(s) bid and within the times and in accordance with the other items and conditions of the Bid Documents.

1.7 Bidder has given LCCC and Architect written notice of all conflicts, errors, ambiguities or discrepancies that the bidder has discovered in the Bid Documents, and the written resolution thereof by LCCC and Architect is acceptable to bidder. The Bid Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the work and/or services for which this Bid is submitted.

1.8 Any assumption, exception or exclusion related to any part of the Bid Documents must be noted prior to Bid Due/Opening Date, and may result in bidder being disqualified or reduced in standing. Assumptions, exceptions or exclusions taken after issuance of a “Notice of Award” document may also result in disqualification.

1.9 Bidder acknowledges receipt of complete Bid Document package, including all incorporated and attached Bid Documents.

1.10 Acknowledgement and compliance with applicable State Statutes is the sole responsibility of the “Prime” or “General” Contractor and all subcontractors. LCCC reserves the right to request written verification of same.

2. **PROJECT SCOPE AND DETAILS**

2.1 The work includes, but is not limited to furnishing all labor, materials, services and equipment required for the selective removal and demolition of existing building and site components, and for the construction of two classroom additions of approximately 1,500 square feet each and one classroom remodel of approximately 1,040 square feet with a temporary exit enclosure, concrete, masonry, structural steel, cold-formed metal framing, miscellaneous metals, rough carpentry, finish carpentry, glue laminated wood beams, plastic laminate faced wood casework, foundation damp proofing, insulation, EPDM and PVC roofing, sheet metal flashings, sealants, expansion
joint assemblies, hollow metal frames, wood doors, access panels, aluminum-framed entrances and storefronts, door hardware, glazing, gypsum board, acoustical panel ceiling, carpet tile and wall base, painting, signage, fire extinguishers, laboratory fume hood, window shades, mechanical systems including ducted air systems and hydronic systems, heat pumps, exhaust fans, plumbing, fire Invitation to Bid Document protection system, electrical systems including power and lighting and communications, fire alarm and security systems, asphalt paving, concrete sidewalks, excavation and backfill, rough grading, and modified landscaping and landscape irrigation system. All materials, services and/or work not specifically mentioned, which are necessary in order to provide a complete project shall be included in the bid and shall conform to all applicable local, state, and federal requirements in accordance with the requirements, terms, specifications, conditions, and provisions hereinafter contained.

2.2 Project Representatives

<table>
<thead>
<tr>
<th>LCCC</th>
<th>Architect’s Representative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bill Zink</td>
<td>Joshua M. Schmidt, AIA, NCARB</td>
</tr>
<tr>
<td>Asst. Director, Physical Plant</td>
<td>Tobin &amp; Associates</td>
</tr>
<tr>
<td>(307) 778-1121</td>
<td>(307) 632-3144 x124</td>
</tr>
<tr>
<td><a href="mailto:bzink@lccc.wy.edu">bzink@lccc.wy.edu</a></td>
<td><a href="mailto:josh@tobin-assoc.com">josh@tobin-assoc.com</a></td>
</tr>
</tbody>
</table>

2.3 Project Schedule

<table>
<thead>
<tr>
<th>Event</th>
<th>Date/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Release bid</td>
<td>October 19, 2018</td>
</tr>
<tr>
<td>Mandatory pre-bid meeting</td>
<td>November 13, 2018 @ 10:00 a.m. in Laramie at ACC campus room 204</td>
</tr>
<tr>
<td>Questions due</td>
<td>November 20, 2018</td>
</tr>
<tr>
<td>Issue last addendum if necessary</td>
<td>November 26, 2018</td>
</tr>
<tr>
<td>Bid opening</td>
<td>November 28, 2018 @ 3:00 p.m.</td>
</tr>
<tr>
<td>Notice of Award</td>
<td>December 5, 2018</td>
</tr>
<tr>
<td>Notice to Proceed w/submittals</td>
<td>December 12, 2018</td>
</tr>
<tr>
<td>Notice to Proceed w/ Exterior Construction</td>
<td>April 15, 2019</td>
</tr>
<tr>
<td>Notice to Proceed w/ Interior Construction</td>
<td>May 20, 2019</td>
</tr>
<tr>
<td>Substantial Completion</td>
<td>September 13, 2019</td>
</tr>
</tbody>
</table>

2.4 Liquidated Damages: For failure to complete the Work on time, it is mutually agreed by and between the parties hereto that time is of the essence and that in the case of the Contractor’s failure to complete the contract within the time specified and agreed upon (substantial completion date), the Owner will be damaged thereby; and because it is difficult to definitely ascertain and prove the amount of said damages, it is hereby agreed that the amount of such damages shall be the liquidated sum of seven hundred fifty dollars ($750.00) per calendar day for every day’s delay in finishing the Work until such time as the Work is completed and accepted via written instrument by
the Owner; and the Contractor hereby agrees that said sum shall be
deducted from monies due the contractor under the contract or if no
money is due the Contractor, the Contractor hereby agrees to pay to
the Owner as liquidated damages, and not by way of penalty, such
total sum as shall be due for such delay.

If the Contractor has not completed all Punch List items within sixty
(60) days from when the list was generated, the Owner may address
the Punch List items with other forces and back-charge the Contractor
for those forces in addition to days of non-compliance.

3. **BASE BID PRICE SCHEDULE**

3.1 The undersigned, in compliance with the Bid Document package
requirements and instructions, having read and examined same, and
having visited the site of the proposed work, and being familiar with
the conditions surrounding the Bid Project, including availability of
materials, utilities and labor, proposes to perform the proposed scope
of work for the proposed price which includes (*but is not limited to*) the
furnishing of labor, materials, shop drawings (*if required*),
transportation, tools, equipment, insurance, bonds, applicable taxes,
temporary provisions, escalation, overhead and profits necessary for the
completion of the work in accordance with and described,
indicated or reasonably inferred per this certain Bid Document
package.

3.2 Each submitted Bid shall provide a Base Bid per Paragraph 3.3
below. Lump sum Base Bid shall be written in words and in figures,
discrepancies between words and figures will be resolved in favor of
written words.

3.3 **Total Base Bid Price (Not to Exceed Sum of):**

<table>
<thead>
<tr>
<th>Total Written in Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>______________________</td>
</tr>
</tbody>
</table>

| $ ____________ |
| Total Written in Figures |

4. **STATE STATUTES AND REGULATIONS**

**WYOMING RESIDENT CONTRACTOR**

4.1 Are you submitting this Bid as a Wyoming Resident Contractor?

☐ No

☐ Yes, my Contractor Residency Certification Number is ___________________, and my bid complies with Wyoming Statutes §16-6-101 through 107 and §16-6-1001. This Bid will be awarded based on the Contractor’s statement of meeting the requirements of these Wyoming Statutes. Subsequent information verifying the statute retirements have been met may be required up to and including possible audits to confirm that the contractor has not subcontracted more than a total of 30% of the work covered by his contract to non-resident subcontractors and non-resident sub-tier contractors and that
other applicable statute requirements have been met. *(Certificate of Residency must be current and on file with the State of Wyoming Department of Employment, Labor Standards Division (307.777.7261).*

### 4.2 Debarment/Suspension:
A Vendor certifies, by submission of their respective Bid, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, sentenced to a denial of State or Federal benefits by State or Federal court, or voluntarily excluded from participation in this transaction by any State or Federal department or agency. Submission is also agreement that LCCC will be notified of any change in this status. Additionally:

- **a)** Have not within a three-year period preceding this transaction been convicted of or had a civil judgment rendered against them for commission of fraud or criminal offense in connection with obtaining, attempting to obtain, or performing a public *(Federal, State, or Local)* transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property; and,
- **b)** Are not presently indicted for or otherwise criminally or civilly charged by a government entity *(Federal, State, or Local)* with commission of any of the offenses enumerated in Paragraph “a” above; and have not within a three-year period preceding this transaction had one or more public transactions *(Federal, State, or Local)* terminated for cause or default.

#### Verification and Certification of Debarment Status
- Presently debarred, suspended, or excluded per the above criteria.
- Not presently debarred, suspended or excluded per the above criteria.

### 4.3 Electrical Apprenticeship Programs on Public Work Projects:
For all public works awarded by the state, the University of Wyoming, a community college or a school district pursuant to W.S. 16-6-101 through 16-6-206 estimated to cost one million dollars ($1,000,000.00) or more, a contractor who commits to ensure that not less than ten percent (10%) of the labor hours shall be worked by apprentices shall have his bid considered as if his bid were one percent (1%) lower than the actual dollar value of his bid. The contractor awarded a contract under this section, after consideration of all other applicable preferences under this chapter, shall be awarded the contract at the actual dollar value of his bid under this section. This subsection shall not apply to those state agencies that have a recognized or approved apprenticeship training program requirement by the United States department of labor or other appropriate federally funded program.

If contractors elect to invoke the resident preference on this project, certification paperwork shall be submitted with the bid package.

**Are you requesting bid preference for having an Apprenticeship Utilization Program in place?**

- **Yes**
- **No**
If yes, you must submit a copy of the Letter of Certification from the US Department of Labor, Wyoming Bureau of Apprenticeship and Training with bid response.

5. **REQUIRED SUBMITTALS (SUBMIT WITH BID)**

The following documents shall be included with your Bid submittal:

5.1 LCCC “BID SUBMITTAL & PRICING DOCUMENT”
5.2 Bid bond or Bid security
5.3 Acknowledgement of any issued Addendums.
5.4 A list of substitutions, clarifications, qualifications, assumptions, or exceptions *(if applicable)*.
5.5 Residency Certification
5.6 OSHA construction Training Certification: Ten (10) hour card for project manager or equivalent.
5.7 CSI Division Assignment Schedule.
5.8 Electrical Apprentice Utilization Program Letter of Certification *(if applicable)*

6. **BID DOCUMENT CHECKLIST**

- LCCC “BID SUBMITTAL & PRICING DOCUMENT” completed, signed in ink and submitted.
- Bid Bond completed and submitted.
- Acknowledged any issued addendum(s) and submitted.
- A listing of substitutions, qualifications, exclusions, exceptions and/or clarifications, submitted on a company letterhead.
- Residency Certification submitted.
- OSHA ten (10) hour card certification.
- CSI Division Work Assignment Schedule
- Electrical Apprentice Utilization Program Letter of Certification *(if applicable)*

7. **APPENDIX – BID ATTACHMENTS**

The following documents are attached hereto and incorporated by reference and shall become a part and condition of this certain Bid.

7.1 Exhibit A: LCCC Insurance Requirements
7.2 Exhibit B: 2018 Building Construction Prevailing Wages
7.3 Exhibit C: CSI Division Work Assignment Schedule
7.4 Exhibit D: Architect’s Project Drawing Package

8. **POST-BID SUBMITTALS**

The undersigned also agrees to furnish the following post-bid submittals to LCCC within ten (10) days after Notice of Award:

8.1 Certificate of Liability Insurance
8.2 Construction Schedule
9. **ADDENDA ACKNOWLEDGEMENT**

9.1 All IFB Addenda must be acknowledged in writing and submitted with Bid. Confirmation and receipt of all issued Addenda is the responsibility of each prospective firm to verify. Verification can be obtained by contacting the LCCC Purchasing Office via e-mail at: jspezzano@lccc.wy.edu.

**Bid No.:** IFB-19060

**Project Description:** LCCC ACC Classroom Addition

I, the undersigned, hereby acknowledge receipt of the following addenda for LCCC Bid No IFB-19060:

Addendum No._____; Addendum No._____; Addendum No._____; Addendum No._____

Name of Bidder – Company Name

______________________________________________________________________________

Signature________________________________________ Printed Name________________________________________

Title________________________________________ Date________________________________________
10. **SIGNATURE PAGE**

10.1 Signature page must be completed in its’ entirety and submitted with Bid Document package.

10.2 Signature page must be signed by firm’s authorized agent, failure to do so will result in rejection of said bid as being unacceptable and non-responsive.

The undersigned, as an authorized agent for the Firm named below, acknowledges that he/she has examined, read, and understands this Request for Bid with its’ incorporated or related documents, and hereby offers to furnish all labor, materials, equipment, services, and information necessary to comply with the requirements, terms, specifications, conditions, and provisions set forth herein.

<table>
<thead>
<tr>
<th>Authorized Signature</th>
<th>Printed Name</th>
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</thead>
<tbody>
<tr>
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<table>
<thead>
<tr>
<th>Title</th>
<th>Name of Firm</th>
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<table>
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<tr>
<th>Mailing Address</th>
<th>City, State, Zip</th>
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<table>
<thead>
<tr>
<th>Phone #</th>
<th>Fax #</th>
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<tr>
<td></td>
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</tr>
</tbody>
</table>

E-mail address

Dated this ______ day of ____________________, 2018

**Bidder must return this entire “BID SUBMITTAL & PRICING DOCUMENT”, along with each document described in Article 6 above titled Bid Document Checklist.**

END OF SECTION THREE
EXHIBIT B

INSURANCE REQUIREMENTS

CERTIFICATE OF LIABILITY INSURANCE

A. Insurance Coverage/Limits:

Contractor and each of its subcontractors hereunder, if any, shall at its own expense, obtain insurance as provided below from reliable insurance companies acceptable to Laramie County Community College (LCCC) and authorized to do business in the State of Wyoming, in which the Work is to be performed, with limits as specified in U.S. currency or equivalent. Such insurance shall be in force at the time the Work is commenced and shall remain in force for the duration of this Contract/Agreement, unless a later date is specified below.

a. Workers’ Compensation and Employer’s Liability Insurance: Workers’ Compensation insurance or its’ equivalent (including Occupational Disease coverage) as required by law for all employees, agents, and subcontractors. Employer’s Liability Insurance (including Occupational Disease coverage) in the amount of $1,000,000.00 per accident. Such insurance shall provide coverage in the location in which the work is performed and the location in which the Contractor is domiciled. The Contractor expressly agrees to comply with all provisions of the Workers’ Compensation Laws of the state(s) or country wherein said work is being performed.

b. General Liability Insurance: Commercial General Liability insurance covering all operations by or on behalf of Contractor against claims for bodily injury (including mental injury, mental anguish, and death) and property damage (including loss of use). The Commercial General Liability policy will include limits as follows:

i. General Aggregate $1,000,000.00

ii. Products and Completed Operations $1,000,000.00

iii. Personal Injury and Advertising Injury $1,000,000.00

iv. Each Occurrence $1,000,000.00

v. Damage to Premises Rented $100,000.00

vi. Medical Expense $5,000.00

If the policy is written on a claims-made basis, the Contractor will include an automatic extended reporting period of at least five (5) years past the expiration date of the policy.

c. Automobile Liability Insurance: Automobile Liability insurance against claims of bodily injury (including death) and property damage (including loss of use) covering all owned, rented, leased, non-owned, and hired vehicles used in the performance of the Work, with a minimum
limit of $1,000,000.00 per accident for bodily injury and property damage combined and containing appropriate uninsured motorist and No-Fault insurance provision wherever applicable.

d. **Excess Insurance**: Excess (or Umbrella) Liability insurance with a minimum limit of $2,000,000.00 per occurrence/$2,000,000.00 annual aggregate. This insurance shall provide coverage in excess of the underlying primary liability limits, terms, and conditions for each category of liability insurance in the foregoing subsections a, b, and c. This insurance shall be written on a following form basis of underlying coverage, and the aggregate limits, if any, shall apply separately to each annual policy period. If this insurance is written on a claims-made policy form, then the policy shall be endorsed to include an automatic extended period of at least five (5) years.

### B. Policy Requirements

a. **Certificate Proof**: Prior to the commencement of the respective Contract and/or Agreement, the successful Contractor shall deliver certificates of insurance evidencing such policy or polices to the LCCC Director of Procurement and Contracting specific “Certification” proof shall include:

   i. Certificate of Liability insurance form.

   ii. State of Wyoming, Department of Employment “Unemployment Insurance Certificate of Good Standing”.

   iii. State of Wyoming, Department of Employment “Workers’ Compensation Certificate of Good Standing”.

“Certification” may be mailed, faxed or emailed to:

- E-mail: jspezzano@lccc.wy.edu
- Fax: 307-778-4300 (Attn: Director, Procurement and Contracting)
- Mail: 1400 East College Drive, Cheyenne, WY 82007 (Attn: Director, Procurement and Contracting)

b. **Additional Insured Clause**: LCCC shall be listed as the “Additional Insured” on all policies, but only with respect to operations of successful firm under the respective Contract.

c. **Notice of Cancellation**: Each insurance policy required by the insurance provisions of this Contract shall provide the required coverage and shall not be canceled or non-renewed except after thirty (30) days prior written notice has been given to LCCC, except when cancellation is for non-payment of premium, then ten (10) days prior notice may be given. Such notice shall be sent directly to LCCC, Director of Procurement and Contracting.

Updated on April 14, 2015
Exhibit C to IFB-19060/CSI Division Work Assignment Schedule

Complete the information requested below per the applicable CSI Division required for this Bid. Any portion of the form not filled in will be considered non-conforming and an irregularity, and may affect the award of this Bid. EXCEPTION: Any Division not applicable to this Bid may be left void or blank.

PROJECT: LCCC ACC Classroom Addition

DATE: November 28, 2018

ARCHITECT/ENGINEER: Tobin & Associates

CONTRACTOR NAME: 

**Do not combine categories of work; list separately per respective Construction Specification Institute (CSI) Division.**

<table>
<thead>
<tr>
<th>WORK DESCRIPTION CSI Division</th>
<th>PRIME, SUBCONTRACTOR, SUPPLIER Name, City and State</th>
<th><strong>WORK LEVEL SP or Tier 1</strong></th>
<th>% of BID VALUE</th>
<th>BID AMOUNT</th>
<th>TRADES Performed by Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>Div 01: General Requirements</td>
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<td>Div 02: Existing Conditions</td>
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<td>Div 03: Concrete</td>
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<td>Div 04: Masonry</td>
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<tr>
<td>Div 05: Metals</td>
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<tr>
<td>Div 06: Wood, Plastics, Composites</td>
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<td>$</td>
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<tr>
<td>WORK DESCRIPTION CSI Division</td>
<td>PRIME, SUBCONTRACTOR, SUPPLIER Name, City and State</td>
<td><strong>WORK LEVEL SP or Tier 1</strong></td>
<td>% of BID VALUE</td>
<td>BID AMOUNT</td>
<td>TRADES Performed by Division</td>
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<tr>
<td>Div 07: Thermal &amp; Moisture Protection</td>
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<td></td>
<td>$</td>
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<tr>
<td>Div 08: Openings</td>
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<td></td>
<td></td>
<td>$</td>
<td></td>
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<td>Div 09: Finishes</td>
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<td></td>
<td></td>
<td>$</td>
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<td>Div 10: Specialities</td>
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<td>Div 11: Equipment</td>
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<td>Div 12: Furnishings</td>
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<td>$</td>
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<td>Div 13: Special Construction</td>
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<td>Div 21: Fire Suppression</td>
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<td>Div 22: Plumbing</td>
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<td>Div 23: HVAC</td>
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<tr>
<td>WORK DESCRIPTION CSI Division</td>
<td>PRIME, SUBCONTRACTOR, SUPPLIER Name, City and State</td>
<td>**WORK LEVEL SP or Tier 1</td>
<td>% of BID VALUE</td>
<td>BID AMOUNT</td>
<td>TRADES Performed by Division</td>
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<tr>
<td>Div 25: Integrated Automation</td>
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<td>Div 26: Electrical</td>
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<tr>
<td>Div 27: Communication</td>
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<tr>
<td>Div 28: Electronic Safety &amp; Security</td>
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<tr>
<td>Div 31: Earthwork</td>
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<td>Div 32: Exterior Improvements</td>
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<tr>
<td>Div 33: Utilities</td>
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<tr>
<td>Other – Please specify</td>
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</tbody>
</table>

**Totals of: % of Bid Value and Bid Amount** (% must add up to 100 and Bid must equal RFB-16045 Bid Value) $ 

1. Fill in information for each Division of work to be completed under this Bid, even if, the work is self-performed by the General Contractor.
2. ** Work Level Descriptions: SP = Self performed by Prime/General Contractor; Tier I: Subcontractor to Prime/GC;
### 2018 Heavy and Highway Prevailing Wages Including Statewide (All Counties) Wages

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Craft Description</th>
<th>Basic Hourly Rate</th>
<th>Method</th>
<th>Fringe Benefit Method</th>
<th>Local Statewide (All Counties)</th>
<th>Local Statewide (All Counties)</th>
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<tbody>
<tr>
<td>101</td>
<td>Laborers: Group 1</td>
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<td>3</td>
<td>3</td>
<td>$16.79</td>
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<td>960</td>
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### 2018 Building Construction Prevailing Wages

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<th>Code No.</th>
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<th>Method</th>
<th>Fringe Benefit Method</th>
<th>Method</th>
<th>Method</th>
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<tr>
<td>2300</td>
<td>Rollers</td>
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<td>2400</td>
<td>Bricklayers and Masons</td>
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<td>3</td>
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<td>Carpenters and Joiners</td>
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<td>Electricians</td>
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<td>2600</td>
<td>Elevator Constructors</td>
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<td>4</td>
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<td>Iron Workers</td>
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<td>Operating Engineers - Group II</td>
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<tr>
<td>6050</td>
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<td>$13.00</td>
<td></td>
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<tr>
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<td>$22.83</td>
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</tbody>
</table>

### Notes:

**Methods**

1. **Majority.** If 50% or more of workers or more within a labor group earn the same wage/fringe benefit, this becomes the prevailing wage/fringe benefit benefit for the labor group in the respective district. If two different wages/benefits each account for 50% for a labor group within a district, a weighted average is performed.

2. **Significant Minority.** If 30% of workers or more within a labor group earn the same wage, this becomes the prevailing wage for the labor group in the respective district. If two different wages each account for 30% for a labor group within a district, a weighted average is performed. This method is not used for benefits computations.

3. **Weighted Average.** If no significant minority exists for a wage/fringe benefit, the prevailing wage/fringe benefit is calculated as \( \frac{[\text{Total Hourly Wage} \times \text{Fringe Benefit}] \times \text{Number of Workers}}{\text{Total Wages Or Benefits Paid} \times \text{Hours Worked}} \).

**Mowing Average Wage.** If no data is received by the survey for a particular classification an inflation adjustment is applied based on the previous year wage and benefit according to rules and regulations of the Department of Workforce Services.

If 30% or more of reported workers were party to a collective bargaining agreement (CBA), the current CBA wage rates were used (as long as Method 1 does not apply). If 50% or more of workers were reported party to a CBA, current CBA wage and benefits are used (incl. only benefits levels for health, pension, vacation and apprenticeship). Highlighted sections indicate trades where skill adjustment may be necessary to ensure higher skilled positions pay at least equal to lower skilled occupations.

Contact with questions or to receive a copy: Kelly Rosebery, Workforce Standards & Compliance Administrator. Labor Standards, (307) 777-7261. Objectives to the rates must be filed with the Director of the Department of Workforce Services, John Cox, Director, 1510 E. Pershing Blvd., West Wing, Room 150, Cheyenne, WY 82002, and received within 15 days of this publication. The objection must be in writing and include the specific grounds for objection.

Published: February 18, 2018
Legal No: 37133
SECTION 00 4513
PRE-QUALIFICATION OF
ROOFING CONTRACTORS
Page 1 of 2

SECTION 00 4513- PRE-QUALIFICATION OF PVC ROOFING CONTRACTORS

1. Only roofing manufacturers listed in the Specifications and Addenda will be accepted.

2. The following shall be submitted for approval on or before the 5:00 p.m. November 20, 2018.
   A. Roofing contractor SHALL submit proof that they are currently certified by the manufacturer to install the roofing product specified with a twenty (20) year warranty, and have been certified as such for the past five (5) years (minimum).
   B. List of not less than five (5) projects of comparable size (approximately 5,000 square feet or greater) and scope of work on which the specified PVC Thermoplastic Decor membrane has been used and installed by the roofing contractor. Material and manufacturer shall be the same as that being bid on this project. The list should include at least one project four (4) years old or older, and one project three (3) years or older.

COMPLETE THE PROJECT LIST FORM ATTACHED

Project reference may be contacted during the review process and the following criteria may be used in making evaluations:

1. Are warranty-related issues addressed within 41 days of notifications?
2. Were punch list items corrected or repaired within 41 days of Substantial Completion?
3. Was the project completed on schedule?
4. Were warranty punch list items completed within 90 days following notification?

Contractors may submit additional relevant information.
Roofing Contractors shall complete the following questions regarding projects, and submit this form with the Bid Form.

1. Do you currently have any projects that are incomplete, 30 days beyond Substantial Completion?  
   Yes  No

2. Do you currently have any warranty-related issues that are incomplete after 90 days following notification?  
   Yes  No

Provide the following information.

<table>
<thead>
<tr>
<th>Project List</th>
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<tbody>
<tr>
<td>Location</td>
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<td>4.</td>
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</table>

* All systems should be PVC Thermoplastic  
** Manufacturer shall be the same on all projects and the same as the product being bid.
SECTION 00 4513
PRE-QUALIFICATION OF
ROOFING CONTRACTORS
Page 1 of 2

SECTION 00 4513 - PRE-QUALIFICATION OF EPDM ROOFING CONTRACTORS

1. Only roofing manufacturers listed in the Specifications and Addenda will be accepted.

2. The following shall be submitted for approval on or before the 5:00p.m. November 20, 2018.
   A. Roofing contractor SHALL submit proof that they are currently certified by the manufacturer to install the roofing product specified with a twenty (20) year warranty, and have been certified as such for the past five (5) years (minimum).
   B. List of not less than five (5) projects of comparable size (approximately 2,000 square feet or greater) and scope of work on which the specified EPDM membrane has been used and installed by the roofing contractor. Material and manufacturer shall be the same as that being bid on this project. The list should include at least one project four (4) years old or older, and one project three (3) years or older.

COMPLETE THE PROJECT LIST FORM ATTACHED

Project reference may be contacted during the review process and the following criteria may be used in making evaluations:

1. Are warranty-related issues addressed within 41 days of notifications?
2. Were punch list items corrected or repaired within 41 days of Substantial Completion?
3. Was the project completed on schedule?
4. Were warranty punch list items completed within 90 days following notification?

Contractors may submit additional relevant information.
Roofing Contractors shall complete the following questions regarding projects, and submit this form with the Bid Form.

1. Do you currently have any projects that are incomplete, 30 days beyond Substantial Completion?  
   Yes  No

2. Do you currently have any warranty-related issues that are incomplete after 90 days following notification?  
   Yes  No

Provide the following information.

<table>
<thead>
<tr>
<th>Project List</th>
</tr>
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<tbody>
<tr>
<td>Location</td>
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<td>1.</td>
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<td>4.</td>
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<tr>
<td>5.</td>
</tr>
</tbody>
</table>

* All systems should be EPDM
** Manufacturer shall be the same on all projects and the same as the product being bid.
PART 1 GENERAL

1.01 PROJECT
   A. Project Name: LCCC ACC Classroom Addition
   B. Owner's Name: Laramie County Community College.
   C. Architect's Name: Tobin & Associates P.C.
   D. The Project consists of the construction of two classroom additions of approximately 1,500 square feet each and remodel of one existing classroom space.

1.02 CONTRACT DESCRIPTION
   A. Contract Type: A single prime contract based on a Stipulated Price as described in the Invitation for Bid - Construction Services, IFB-17144.

1.03 WORK BY OWNER
   A. Owner will supply the following for installation by Contractor:
      1. Flat screen video display monitor and mounting unit
      2. Caulkboard.

1.04 OWNER OCCUPANCY
   A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
   B. Owner intends to occupy the Project upon Substantial Completion.
   C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
   D. Schedule the Work to accommodate Owner occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES
   A. Construction Operations: Limited to areas noted on Drawings.
   B. Arrange use of site and premises to allow:
      1. Owner occupancy.
      2. Use of site and premises by the public.
   C. Provide access to and from site as required by law and by Owner:
      1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
      2. Provide temporary barrier tunnel to protect occupants while maintaining useable exit through construction zone.
      3. Do not obstruct roadways, sidewalks, or other public ways without permit.
   D. Utility Outages and Shutdown:
      1. Limit disruption of utility services to hours the building is unoccupied.
      2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
      3. Prevent accidental disruption of utility services to other facilities.

1.06 WORK SEQUENCE
   A. Construct Work in all three locations, per schedule indicated in Information Available to Bidders, during the construction period:
   B. Coordinate construction schedule and operations with Owner.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION
LCCC ACC CLASSROOM ADDITION
INFORMATION AVAILABLE TO BIDDERS

1. SCHEDULE OF EVENTS

May be changed by addenda or mutual agreement between Owner and successful Bidder prior to signing Contract, Change Order after signing of Contract or other legitimate reason.

a. First Advertisement, 100% Documents Issued October 19, 2018
b. Second Advertisement October 24, 2018
c. Mandatory Pre-Bid Conference November 13, 2018 10:00 AM
d. Last Day of Questions November 20, 2018 5:00 PM
e. Roofing Pre-Qualification Forms Due November 20, 2018 5:00 PM
f. Date of Last Addendum November 26, 2018
g. Bid Opening November 28, 2018 3:00PM
h. Notice of Award Issued December 5, 2018
i. Notice to Proceed with Submittals December 12, 2018
j. Notice to Proceed with Exterior Construction April 15, 2019
k. Notice to Proceed with Interior Construction May 20, 2019
l. Substantial Completion September 13, 2019

2. FACILITY ACCESS FOR CONSTRUCTION

The Contractor shall coordinate with college officials for functions during the Spring and Summer months to avoid disruptions to planned events and uses during times of construction. The following is list of events schedule or tentatively scheduled events for the Spring and Summer of 2019 which may affect the work. This list of events is subject to change.

Finals Week: May 13 – May 17, no excessive noise during this period.

The Contractor shall have access to the building on weekends but shall still coordinate with the college officials for possible college related functions.
SECTION 01 2000 - PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Procedures for preparation and submittal of applications for progress payments.
   B. Documentation of changes in Contract Sum and Contract Time.
   C. Change procedures.
   D. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS
   A. Invitation for Bid - Construction Services, IFB-17144: Payment Schedule.

1.03 SCHEDULE OF VALUES
   A. Form to be used: AIA G703.
   B. Forms filled out by hand will not be accepted.
   C. Submit Schedule of Values in pdf within 10 days after date of Owner-Contractor Agreement.
   D. Identify major categories of work and related monetary values.
   E. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS
   A. Payment Period: Submit at intervals stipulated in the Agreement.
   B. Form to be used: AIA G702 and G703.
   C. Forms filled out by hand will not be accepted.
   D. For each item, provide a column for listing each of the following:
      1. Item Number.
      2. Description of work.
      4. Previous Applications.
      5. Work in Place and Stored Materials under this Application.
      6. Authorized Change Orders.
      7. Total Completed and Stored to Date of Application.
      8. Percentage of Completion.
     10. Retainage.
   E. Execute certification by signature of authorized officer.
   F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
   G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
   H. Submit pdf copies of each Application for Payment.
   I. Include the following with the application:
      1. Transmittal letter as specified for submittals in Section 01 3000.
      2. Affidavits attesting to off-site stored products.

1.05 MODIFICATION PROCEDURES
   A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to the Contract Documents.
   B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change. Contractor shall prepare and submit a fixed price quotation within 10 days.

D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 6000.

E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
   1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
   2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.

F. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

G. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

H. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

1.06 APPLICATION FOR FINAL PAYMENT
   A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

   B. Application for Final Payment will not be considered until the following have been accomplished:
      1. All closeout procedures specified in Section 01 7000.
      2. All punch list items are completed.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION
SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.
B. Electronic document submittal.
C. Preconstruction meeting.
D. Progress meetings.
E. Construction progress schedule.
F. Request for Information.
G. Submittals for review, information, and project closeout.
H. Number of copies of submittals.
I. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.
B. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format and transmitted via email.
1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
2. Contractor and Architect are required to use this procedure.
3. It is Contractor's responsibility to submit documents in allowable format.
4. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

3.02 PRECONSTRUCTION MEETING

A. Schedule meeting after Notice to Proceed.
B. Attendance Required:
   1. Owner.
   3. Contractor.
   4. Major Subcontractors.
   5. Major Design Consultants.
C. Agenda:
   1. Distribution of Contract Documents.
   2. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
3. Designation of personnel representing the parties to Contract, Owner, General Contractor and Architect.
4. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
5. Scheduling.
6. Use of premises by Owner and Contractor.
D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS
A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.
B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major Subcontractors and Design Consultants as appropriate to address agenda topics.
D. Agenda:
1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. Other business relating to work.
E. Record minutes and distribute copies within two days after meeting to participants, with pdf copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE
A. Within 10 days after date of the Agreement, submit preliminary schedule.
B. If preliminary schedule requires revision after review, submit revised schedule within 3 days.
C. Submit updated schedule with each Application for Payment.

3.05 REQUEST FOR INFORMATION
A. Document Interpretation:
1. Design intent may be discussed at coordination meetings or via telephone or email as the work progresses.
2. Exchange of complex information that clarifies design intent may be communicated via a contractor initiated Request for Information (RFI) using form AIA G716.
3. Architect shall provide a RFI response with written information, drawings or other documentation within 10 days of initial request date. Information may be exchanged in the form of Architect's Supplemental Instructions using form AIA G710.
4. If the resultant information creates a change of work, modification procedures shall be executed per Section 01 2000 Price and Payment Procedures and per the Contract Agreement.
3.06 SUBMITTALS FOR REVIEW
   A. When the following are specified in individual sections, submit them for review:
      1. Product data.
      2. Shop drawings.
      3. Samples for selection.
      4. Samples for verification.
   B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in the contract documents.
   C. Samples will be reviewed for aesthetic, color, or finish selection.
   D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below.

3.07 SUBMITTALS FOR INFORMATION
   A. When the following are specified in individual sections, submit them for information:
      1. Design data.
      2. Certificates.
      3. Test reports.
      4. Inspection reports.
      5. Manufacturer's instructions.
      6. Manufacturer's field reports.
      7. Other types indicated.
   B. Submit for Architect's knowledge as contract administrator or for Owner.

3.08 SUBMITTALS FOR PROJECT CLOSEOUT
   A. Submit Correction Punch List for Substantial Completion.
   B. Submit Final Correction Punch List for Substantial Completion.
   C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
      1. Project record documents.
      2. Operation and maintenance data.
      3. Warranties.
      5. Other types as indicated.
   D. Submit for Owner's benefit during and after project completion.

3.09 NUMBER OF COPIES OF SUBMITTALS
   A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
   B. Samples: Submit the number specified in individual specification sections; two of which will be retained by Architect and Owner.
      1. Retained samples will not be returned to Contractor unless specifically so stated.

3.10 SUBMITTAL PROCEDURES
   A. General Requirements:
   B. Shop Drawing Procedures:
      1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
      2. Use of reproductions of the Contract Documents in digital data format may be allowed for creation of shop drawings. Obtain files from Architect via execution of Digital Model Sharing Agreement. Sample of agreement form follows this Section.
      3. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.
C. Transmit each submittal with a copy of approved submittal form.
D. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
E. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
F. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
G. Schedule submittals to expedite the Project, and coordinate submission of related items.
H. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
I. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
J. Provide space for Contractor and Architect review stamps.
K. When revised for resubmission, identify all changes made since previous submission.
L. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
M. Submittals not requested will not be recognized or processed.

END OF SECTION
AGREEMENT & RELEASE REGARDING DIGITAL MODEL SHARING & USE OF ELECTRONIC INSTRUMENTS OF SERVICE PREPARED BY
TOBIN & ASSOCIATES, P.C.

LCCC ACC Classroom Addition
Laramie, Wyoming

TERMS & CONDITIONS

In connection with the project identified above (hereinafter "Project") for which Tobin & Associates, P.C. ("Architect") has been retained to provide Architectural services, Recipient has requested certain Instruments of Service prepared by the Architect electronic modeling format (Autodesk AutoCAD file format) hereinafter referred to as "Electronic Model and Document."

In consideration of Tobin & Associates, P.C.’s agreement to release Electronic Documents, the Recipient agrees as follows:

____________________________
(hereinafter "Recipient") understands and acknowledges that the Electronic Model and Documents prepared for the Project were not created or intended for direct use as construction documentation by the Recipient, its sub-Recipients or third parties, and that after the Electronic Model and Documents are provided they can become digitally corrupted without detection, can be modified without the knowledge of the Architect and/or its consultants, may not be readable by Recipient, its sub-Recipients or by third parties due to file format incompatibilities, and may be modified by the Architect, its consultants or others after the Electronic Model and Documents are transferred, any of which circumstances could cause damage or loss to Recipient. Any further conversion of the format by the Recipient is solely the responsibility of the Recipient. The conversion of Electronic Model and Documents from the machine-readable format used by the Architect to some other format may introduce errors of other inaccuracies. Recipient understands and acknowledges that these risks are inherent with any use of the Electronic Model and Documents and that the use of the Electronic Model and Documents may not result in the detection of all potential conflicts between elements during actual construction of a project and may not accurately reflect quantities, surface areas or volumes necessary to complete or estimate the cost of the Work.

The Architect does not warrant that the information contained in the Electronic model and Documents is free from errors or omissions, or free from damage or deletion in part or in whole. The Recipient may not rely on the accuracy or completeness of the Electronic Documents and/or Electronic Model. The Recipient accepts all responsibility for any errors or inaccuracies and releases the Architect from any liability or claims for recovery of damages or expenses arising as the result of such error or inaccuracies. Recipient agrees that dimensions may not be scaled in the Electronic Model and Documents and that written dimension on the hard-copy Contract Documents take precedence.

Recipient acknowledges that the Electronic Model and Documents are a work in progress for the above-described Project. The signed and sealed original plans, specifications and other documents constitute the Contract Documents for the Project. The Electronic Model and Documents are not Contract Documents, and will not be signed or sealed by Tobin & Associates, P.C. The Recipient shall be obligated to remove the Architect's and/or the Architect's consultant's title blocks and all digital seals from the Electronic Documents. Architect cannot verify that the Electronic Model and Documents accurately or completely reflect field conditions. The Recipient and each other user must satisfy themselves as to the level of accuracy and completeness of the Electronic Model and Documents for their needs. In addition, the Recipient understands that the changes made during design, bidding, negotiation and construction may not be incorporated into the Electronic Model and Documents.

Recipient acknowledges that the transfer of Electronic Model and Documents shall not constitute the sale of goods; and, Owner, Architect and its consultants make NO WARRANTY, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PURPOSE, INCLUDING "SPEARIN" TYPE WARRANTIES, IN CONNECTION WITH THE SERVICE OF PROVIDING ELECTRONIC MODEL AND DOCUMENTS, OR THAT THE ELECTRONIC MODEL AND DOCUMENTS WILL BE USEABLE OR ACCURATE, WHICH WARRANTIES AND REPRESENTATIONS ARE EXPRESSLY DISCLAIMED.

By acceptance of the Electronic Model and Documents, Recipient agrees not to sue, and will hold harmless Architect and each of its partners, officers, shareholders, directors, employees, and consultants from any and all costs (including reasonable attorneys' fees), claims or causes of action be it tort, breach of contract or otherwise arising as the result of either: 1) Recipient's failure to comply with any of the requirements of this Agreement or 2) Defects, errors, or omissions in the Electronic Model and Documents or the information contained therein and , specifically, Recipient's use of the Electronic Model. Recipients use of the Electronic Model and Documents is at the Recipient's sole risk.

Signatures on following page

AGREEMENT ACCEPTANCE
SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. References and standards.
   B. Control of installation.
   C. Mock-ups.
   D. Tolerances.
   E. Manufacturers' field services.
   F. Defect Assessment.

1.02 RELATED REQUIREMENTS
   A. Section 01 3000 - Administrative Requirements: Submittal procedures.
   B. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCES AND STANDARDS
   A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
   B. Conform to reference standard of date of issue current on date specified in the individual specification sections, except where a specific date is established by applicable code.
   D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION
   A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
   B. Comply with manufacturers' instructions, including each step in sequence.
   C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
   D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
   E. Have work performed by persons qualified to produce required and specified quality.
   F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
   G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS
   A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
   B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
C. Notify Architect seven (7) working days in advance of dates and times when mock-ups will be constructed.

D. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.

E. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

G. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.

H. Accepted mock-ups shall be a comparison standard for the remaining Work.

I. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

### 3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

### 3.04 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

### 3.05 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Code-required special inspections.
B. Testing services incidental to special inspections.
C. Submittals.
D. Manufacturers' field services.
E. Fabricators' field services.

1.02 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements.
B. Section 01 6000 - Product Requirements: Requirements for material and product quality.
C. Structural Drawings: Requirements for special inspections.

1.03 DEFINITIONS

B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
C. National Institute of Standards and Technology (NIST).
D. Special Inspection:
   1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved contract documents and the referenced standards.
   2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

1.04 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
C. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2015ae1.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency shall:
1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
3. Submit certification that Special Inspection Agency is acceptable to AHJ.

C. Testing Agency Qualifications: Prior to the start of work, the Testing Agency shall:
   1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
   3. Submit certification that Testing Agency is acceptable to AHJ.

D. Special Inspection Reports: After each special inspection, Special Inspector shall promptly submit pdf copies of report; one to Architect and one to the Owner.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of Special Inspector.
      d. Date and time of special inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of special inspection.
      h. Date of special inspection.
      i. Results of special inspection.
      j. Compliance with Contract Documents.

E. Test Reports: After each test or inspection, promptly submit pdf copies of report; one to Architect and one to Owner.

F. Manufacturer's Field Reports: Submit reports to Architect and Owner.
   1. Submit report within 10 days of observation to Architect for information.
   2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the contract documents.

1.06 SPECIAL INSPECTION AGENCY
A. Contractor shall employ services of a Special Inspection Agency to perform inspections and associated testing in accordance with ASTM E329 and required by the building code.
B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.07 TESTING AND INSPECTION AGENCIES
A. Contractor shall employ services of an independent testing agency to perform additional testing and sampling associated with special inspections but not required by the building code.
B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL
A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
   1. Continuous Special Inspection: Special Inspection Agency shall be present in the area where the work is being performed and observe the work at all times the work is in progress.
2. Periodic Special Inspection: Special Inspection Agency shall be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

3.02 SPECIAL INSPECTIONS FOR STRUCTURAL CONSTRUCTION
   A. See Structural Drawings for special inspection requirements.

3.03 SPECIAL INSPECTIONS FOR STEEL CONSTRUCTION
   A. High-Strength Bolt, Nut and Washer Material:
      1. Verify identification markings comply with ASTM standards specified in the approved contract and to AISC 360, Section A3.3; periodic.
      2. Submit manufacturer's certificates of compliance; periodic.
   B. High-Strength Bolting Installation: Verify items listed below comply with AISC 360, Section M2.5.
      1. Snug tight joints; periodic.
   C. Structural Steel and Cold Formed Steel Deck Material:
      1. Structural Steel: Verify identification markings comply with AISC 360, Section M3.5; periodic.
      2. Other Steel: Verify identification markings comply with ASTM standards specified in the approved contract documents; periodic.
      3. Submit manufacturer's certificates of compliance and test reports; periodic.
   D. Weld Filler Material:
      1. Verify identification markings comply with AWS standards specified in the approved contract documents and to AISC 360, Section A3.5; periodic.
      2. Submit manufacturer's certificates of compliance; periodic.
   E. Welding:
      1. Structural Steel and Cold Formed Steel Deck:
         b. Multipass Fillet Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
         d. Plug and Slot Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
         e. Single Pass Fillet Welds 5/16 inch or Greater: Verify compliance with AWS D1.1/D1.1M; continuous.
         f. Roof Deck Welds: Verify compliance with AWS D1.3/D1.3M; continuous.
   F. Steel Frame Joint Details: Verify compliance with approved contract documents.
      1. Details, bracing and stiffening; periodic.
      2. Member locations; periodic.
      3. Application of joint details at each connection; periodic.

3.04 SPECIAL INSPECTIONS FOR CONCRETE CONSTRUCTION
   A. Reinforcing Steel, Including Prestressing of Tendons and Placement: Verify compliance with approved contract documents and ACI 318, Sections 3.5 and 7.1 through 7.7; periodic.
   B. Anchors Installed in Hardened Concrete: Verify compliance with ACI 318, Sections 3.8.6, 8.1.3, and 21.2.8; periodic.
   C. Design Mix: Verify plastic concrete complies with the design mix in approved contract documents and with ACI 318, Chapter 4 and 5.2; periodic.
   D. Concrete Sampling Concurrent with Strength Test Sampling: Each time fresh concrete is sampled for strength tests, verify compliance with ASTM C172/C172M, ASTM C31/C31M and ACI 318, Sections 5.6 and 5.8 and record the following, continuous:
      1. Slump.
      2. Air content.
3. Temperature of concrete.

E. Specified Curing Temperature and Techniques: Verify compliance with approved contract documents and ACI 318, Sections 5.11 through 5.13; periodic.

F. Formwork Shape, Location and Dimensions: Verify compliance with approved contract documents and ACI 318, Section 6.1.1; periodic.

G. Materials: If the Contractor cannot provide sufficient data or documentary evidence that concrete materials comply with the quality standards of ACI 318, the AHJ will require that the Special Inspector verify compliance with the appropriate standards and criteria in ACI 318, Chapter 3.

3.05 SPECIAL INSPECTIONS FOR SOILS

A. Materials and Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
   1. Design bearing capacity of material below shallow foundations; periodic.
   2. Design depth of excavations and suitability of material at bottom of excavations; periodic.
   4. Subgrade, prior to placement of compacted fill; periodic.

B. Testing: Classify and test excavated material; periodic.

3.06 SPECIAL INSPECTIONS FOR CAST-IN-PLACE DEEP FOUNDATIONS

A. Materials, Equipment and Final Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
   1. Element length; continuous.
   2. Element diameters and bell diameters; continuous.
   3. Embedment into bedrock; continuous.
   4. End bearing strata capacity; continuous.
   5. Placement locations and plumbness; continuous.
   6. Type and size of hammer; continuous.

B. Drilling Operations: Observe and maintain complete and accurate records for each element; continuous.

C. Material Volume: Record concrete and grout volumes.

D. Concrete Elements Associated with Cast-in-Place Deep Foundations: Perform additional inspections as required by the Special Inspections for Concrete Construction article of this section.

3.07 SPECIAL INSPECTIONS FOR MASTIC AND INTUMESCENT FIRE RESISTANT COATINGS

A. Verify mastic and intumescent fire resistant coatings comply with AWCI 117 and the fire resistance rating indicated on approved contract documents.

3.08 SPECIAL INSPECTIONS FOR WIND RESISTANCE

A. Structural Wood: Glulams
   1. Nailing, bolting, anchoring and other fastening of components within the main wind force-resisting system; periodic.

B. Cold Formed Steel Light Frame Construction:
   1. Field welding; periodic.
   2. Screw attachment, bolting, anchoring and other fastening of components within the main wind force-resisting system; periodic

C. Wind Resisting Components:
   1. Roof decking; periodic.
   2. Wall sheathing; periodic.

D. Structural Observations for Wind Resistance: Visually observe structural system for general compliance with the approved contract documents; periodic.
3.09 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

A. Special Inspection Agency shall:
   2. Perform specified sampling and testing of products in accordance with specified reference standards.
   3. Ascertain compliance of materials and products with requirements of Contract Documents.
   4. Promptly notify Owner, Architect and Contractor of observed irregularities or non-conformance of work or products.
   5. Perform additional tests and inspections required by Owner and/or Architect.
   6. Submit reports of all tests or inspections specified.

B. Limits on Special Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the work.

C. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

D. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.10 TESTING AGENCY DUTIES AND RESPONSIBILITIES

A. Testing Agency Duties:
   1. Test samples submitted by Contractor.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
   6. Perform additional tests and inspections required by Owner and/or Architect.
   7. Submit reports of all tests or inspections specified.

B. Limits on Testing or Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the work.

C. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Owner and/or Architect.

D. Contractor will pay for re-testing required because of non-compliance with specified requirements.

3.11 CONTRACTOR DUTIES AND RESPONSIBILITIES

A. Contractor Responsibilities, General:
   1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
   2. Cooperate with agency and laboratory personnel; provide access to the work.
   3. Provide incidental labor and facilities:
      a. To provide access to work to be tested or inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
      c. To facilitate tests or inspections.
d. To provide storage and curing of test samples.
4. Notify Owner, Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

3.12 MANUFACTURERS' AND FABRICATORS' FIELD SERVICES

A. When specified in individual specification sections, require material suppliers, assembly fabricators, or product manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

END OF SECTION
SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Temporary sanitary facilities.
   B. Temporary Controls: Barriers, enclosures, and fencing.
   C. Security requirements.
   D. Waste removal facilities and services.

1.02 RELATED REQUIREMENTS
   A. Section 01 5100 - Temporary Utilities.

1.03 TEMPORARY SANITARY FACILITIES
   A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
   B. Maintain daily in clean and sanitary condition.

1.04 BARRIERS
   A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
   B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
   C. Provide protection for plants designated to remain. Replace damaged plants.
   D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.05 FENCING
   A. Construction: Commercial grade chain link fence.
   B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.06 EXTERIOR ENCLOSURES
   A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.07 INTERIOR ENCLOSURES
   A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
   B. Construction of enclosures for long term duration: Wood or steel framing an plywood sheathing with sealed joints and sealed edges at intersections with existing surfaces.
   C. Construction of enclosures for short term duration: Wood supports and 10 mil plastic polyethylene sheet.

1.08 SECURITY
   A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.09 VEHICULAR ACCESS AND PARKING
   A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
B. Provide and maintain access to fire hydrants, free of obstructions.
C. Provide means of removing mud from vehicle wheels before entering streets and paved parking lot areas.
D. Designated existing on-site roads may be used for construction traffic.
E. Existing parking areas where designated by owner may be used for construction parking.

1.10 WASTE REMOVAL
A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
B. Provide containers with lids. Remove trash from site periodically.
C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

1.11 FIELD OFFICES
A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture and drawing display table.
B. Provide space for Project meetings, with table and chairs to accommodate 8 persons.

1.12 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS
A. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.
B. Clean and repair damage caused by installation or use of temporary work.
C. Restore existing facilities used during construction to original condition.
D. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION
SECTION 01 5100 - TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Temporary Utilities: Provision of electricity, lighting, heat, ventilation, and water.

1.02 RELATED REQUIREMENTS
   A. Section 01 5000 - Temporary Facilities and Controls:
      1. Temporary sanitary facilities required by law.

1.03 TEMPORARY ELECTRICITY
   A. Cost: By Owner.
   B. Connect to Owner’s existing power service.
      1. Do not disrupt Owner’s need for continuous service.
   C. Provide temporary electric feeder from existing building electrical service at location as directed.
   D. Power Service Characteristics: 120 volt, 100 ampere, single phase, three wire.
   E. Complement existing power service capacity and characteristics as required.
   F. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.
   G. Provide feeder switch at source distribution equipment.
   H. Permanent convenience receptacles may be utilized during construction.
   I. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

1.04 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES
   A. Provide and maintain lighting for construction operations to achieve a minimum lighting level of 2 watt/sq ft.
   B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtailed, and lamps as required.
   C. Maintain lighting and provide routine repairs.
   D. Permanent building lighting may be utilized during construction.

1.05 TEMPORARY HEATING
   A. Cost of Energy: By Contractor.
   B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
   C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
   D. Existing facilities shall not be used.
   E. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.
   F. Do not use permanent equipment for temporary heating purposes when construction operations produce airborne dust and debris. Any dust and debris that is deposited in the mechanical system shall be removed by the Contractor prior to issuance of substantial completion.

1.06 TEMPORARY COOLING
   A. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.
1.07 TEMPORARY VENTILATION
   A. Existing ventilation equipment may not be used.
   B. Provide temporary fan units and ducts as required to maintain clean air for construction operations.

1.08 TEMPORARY WATER SERVICE
   A. Cost of Water Used: By Owner.
   B. Connect to existing water source.
      1. Exercise measures to conserve water.
   C. Extend branch piping with outlets located so water is available by hoses with threaded connections.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION
SECTION 01 5713 - TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prevention of erosion due to construction activities.
B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
C. Restoration of areas eroded due to insufficient preventive measures.
D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS


1.04 PERFORMANCE REQUIREMENTS

A. Comply with all requirements of Wyoming Department of Environmental Quality for erosion and sedimentation control even though a DEQ permit may not be required.
C. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
  1. Obtain and pay for permits and provide security required by authority having jurisdiction.
E. Timing: Put preventive measures in place before disturbance of surface cover.
F. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
  1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
  2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
G. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
  1. Control movement of sediment and soil from temporary stockpiles of soil.
  2. Prevent development of ruts due to equipment and vehicular traffic.
  3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
H. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
   1. Prevent windblown soil from leaving the project site.
   2. Prevent tracking of mud onto public roads outside site.
   3. Prevent mud and sediment from flowing onto sidewalks and pavements.
   4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

I. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

J. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

K. Open Water: Prevent standing water that could become stagnant.

L. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Erosion and Sedimentation Control Plan:
   1. Submit within 2 weeks after Notice to Proceed.
   2. Include:
      a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
      b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
      c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
      d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
      e. Other information required by law.
      f. Format required by law is acceptable, provided any additional information specified is also included.
   3. Obtain the approval of the Plan by authorities having jurisdiction.
   4. Obtain the approval of the Plan by Owner.

C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

2.01 MATERIALS

A. Use plastic bags filled with aggregate or straw bales with stakes to control sediment runoff into waterways.

B. Bales: Air dry, rectangular straw bales.
   1. Cross Section: 14 by 18 inches, minimum.
   2. Bindings: Wire or string, around long dimension.
C. Bale Stakes: One of the following, minimum 3 feet long:
   1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
   2. Wood, 2 by 2 inches in cross section.

D. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
   1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
   2. Permittivity: 0.05 sec⁻¹, minimum, when tested in accordance with ASTM D4491.
   3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
   4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
   5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
   6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533/D4533M.
   7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.

E. Silt Fence Posts: One of the following, minimum 5 feet long:
   1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION
   A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES
   A. Linear Sediment Barriers: Made of silt fences or straw bales.
      1. Provide linear sediment barriers:
         a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
   B. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
      1. Filter fabric in the form of plastic bags filled with course aggregate.
      2. Straw bale row blocking entire inlet face area; anchor into pavement.

3.04 INSTALLATION
   A. Silt Fences:
      1. Store and handle fabric in accordance with ASTM D4873/D4873M.
      2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
      3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
      4. Install with top of fabric at nominal height and embedment as specified.
      5. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
   B. Straw Bale Rows:
      1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
2. Install bales so that bindings are not in contact with the ground.
3. Embed bales at least 4 inches in the ground.
4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
5. Fill gaps between ends of bales with loose straw wedged tightly.
6. Place soil excavated for trench against bales on the upslope side of the row, compacted.

3.05 MAINTENANCE

A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
B. Repair deficiencies immediately.
C. Silt Fences:
   1. Promptly replace fabric that deteriorates unless need for fence has passed.
   2. Remove silt deposits that exceed one-third of the height of the fence.
   3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
D. Straw Bale Rows:
   1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
   2. Remove silt deposits that exceed one-half of the height of the bales.
   3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
E. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
B. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION
SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. General product requirements.
   B. Re-use of existing products.
   C. Transportation, handling, storage and protection.
   D. Product option requirements.
   E. Substitution limitations.
   F. Procedures for Owner-supplied products.
   G. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS
   A. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
   B. Section 01 4000 - Quality Requirements: Product quality monitoring.
   C. Section 01 7419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
   B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
   C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
      1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS
   A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
   B. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
   C. Specific Products to be Reused: The reuse of certain materials and equipment already existing on the project site is noted on Drawings.

2.02 NEW PRODUCTS
   A. Provide new products unless specifically required or permitted by the Contract Documents.
   B. Provide interchangeable components of the same manufacture for components being replaced.

2.03 PRODUCT OPTIONS
   A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
   B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS
A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
B. Deliver and place in location as directed; obtain receipt prior to final payment.

PART 3 EXECUTION
3.01 SUBSTITUTION LIMITATIONS
A. See Section 01 2500 - Substitution Procedures.
B. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period.
C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
D. A request for substitution constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.
E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
F. Substitution Submittal Procedure:
   1. Submit substitution requests by completing the appropriate form shown after this section.
   2. Submit electronic pdf copy of request for substitution for consideration. Limit each request to one proposed substitution.
   3. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
   4. Architect will notify Contractor in writing of decision to accept or reject request.

3.02 OWNER-SUPPLIED PRODUCTS
A. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.
B. Contractor's Responsibilities:
   1. Review Owner reviewed shop drawings, product data, and samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install and finish products.
   4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING
A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer’s instructions.

E. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

F. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

G. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.

B. Store and protect products in accordance with manufacturers’ instructions.

C. Store with seals and labels intact and legible unless noted otherwise.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Provide off-site storage and protection when site does not permit on-site storage or protection.

G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer’s warranty conditions, if any.

I. Do not store products directly on the ground.

J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

K. Prevent contact with material that may cause corrosion, discoloration, or staining.

L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION
## Pre-Bid Request for Substitution

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<tr>
<th>Description/Name</th>
<th>Specified Product</th>
<th>Proposed Substitution</th>
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<td>Manufacturer</td>
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<td>Model No.</td>
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<td>Attachments</td>
<td>☐ Product Data</td>
<td>☐ Material Sample</td>
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<td>Remarks</td>
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<td>☐ Sample Warranty</td>
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<td>Modifications</td>
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<tr>
<td>Will changes be required to the building design or drawing dimensions in order to properly install the proposed substitution?</td>
<td>☐ Yes</td>
<td>☐ No</td>
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<td>Will the undersigned pay for changes to the building design, including engineering and drawing costs, caused by the requested substitution?</td>
<td>☐ Yes</td>
<td>☐ No</td>
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<td>Does the manufacturer’s warranty of the proposed substitution differ from that specified?</td>
<td>☐ Yes</td>
<td>☐ No</td>
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I/we have investigated the proposed substitution and:

- Manufacturer certifies that the proposed substitution is appropriate for the proposed use and is equal or better than the specified product.
- Product Supplier certifies that the proposed substitution is appropriate for the proposed use and is equal or better than the specified product.
- Product Installer certifies that the proposed substitution is appropriate for the proposed use and is equal or better than the specified product.

Signature: ____________________________
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<th>I/we have investigated the proposed substitution and:</th>
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<td>□ Believe that it is equal or superior in all respects to the original specified product.</td>
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<td>□ Will provide the same warranty as required.</td>
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<td>□ Will pay redesign and special installation costs caused by the use of this product.</td>
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<td>□ Will pay additional costs to other contractors caused by the substitution.</td>
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<td>□ Will coordinate the incorporation of the proposed substitution into the Work.</td>
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<td>□ Will modify other parts of the Work as may be necessary to complete the Work.</td>
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SECTION 01 7000 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.
B. Requirements for alterations work, including selective demolition.
C. Pre-installation meetings.
D. Cutting and patching.
E. Surveying for laying out the work.
F. Cleaning and protection.
G. Starting of systems and equipment.
H. Demonstration and instruction of Owner personnel.
I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
B. Section 01 5000 - Temporary Facilities and Controls: Temporary exterior enclosures.
C. Section 01 5000 - Temporary Facilities and Controls: Temporary interior partitions.
D. Section 01 5100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.
E. Section 01 5713 - Temporary Erosion and Sediment Control: Additional erosion and sedimentation control requirements.
F. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
G. Section 02 4100 - Demolition: Demolition of whole structures and parts thereof; site utility demolition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
   3. Submit surveys and survey logs for the project record.
C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   5. Work of Owner or separate Contractor.
   6. Include in request:
      a. Identification of Project.
      b. Location and description of affected work.
      c. Necessity for cutting or alteration.
      d. Description of proposed work and products to be used.
      e. Alternatives to cutting and patching.
      f. Effect on work of Owner or separate Contractor.
      g. Written permission of affected separate Contractor.
      h. Date and time work will be executed.
1.04 QUALIFICATIONS
   A. For survey work, employ a land surveyor registered in Wyoming and acceptable to Owner and Architect. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.

1.05 PROJECT CONDITIONS
   A. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
   B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
   C. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
      1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
      2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
   D. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
      1. Coordinate with Owner time for work that produces loud noise to avoid interference with scheduled classroom activities.
   E. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 COORDINATION
   A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
   B. Notify affected utility companies and comply with their requirements.
   C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
   D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
   E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
   F. Coordinate completion and clean-up of work of separate sections.
   G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS
2.01 PATCHING MATERIALS
   A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
   B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
   C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.
PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
C. Examine and verify specific conditions described in individual specification sections.
D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION
A. Clean substrate surfaces prior to applying next material or substance.
B. Seal cracks or openings of substrate prior to applying next material or substance.
C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS
A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
B. Require attendance of parties directly affecting, or affected by, work of the specific section.
C. Notify Architect four days in advance of meeting date.
D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.
E. Record minutes and distribute copies within two days after meeting to participants, with electronic pdf copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK
A. Verify locations of survey control points prior to starting work.
B. Promptly notify Architect of any discrepancies discovered.
C. Contractor shall locate and protect survey control and reference points.
D. Control datum for survey is that indicated on drawings.
E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
H. Utilize recognized engineering survey practices.
I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
2. Grid or axis for structures.
3. Building foundation, column locations, ground floor elevations.
J. Periodically verify layouts by same means.
K. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS
A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS
A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as indicated.
2. Report discrepancies to Architect before disturbing existing installation.
3. Beginning of alterations work constitutes acceptance of existing conditions.
B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000.
C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
D. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.
2. Relocate items indicated on drawings.
3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and Security): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
3. Verify that abandoned services serve only abandoned facilities.
4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
   1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
   2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
   3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
I. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
J. Clean existing systems and equipment.
K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
L. Do not begin new construction in alterations areas before demolition is complete.
M. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING
A. Whenever possible, execute the work by methods that avoid cutting or patching.
B. See Alterations article above for additional requirements.
C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.
D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
G. Restore work with new products in accordance with requirements of Contract Documents.
H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
I. At penetrations of walls, partitions, ceiling, or floor construction, completely seal voids with appropriate material, to full thickness of the penetrated element.

J. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING
A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
B. Remove debris and rubbish from pipe chases, plenums and other closed or remote spaces, prior to enclosing the space.
C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK
A. Protect installed work from damage by construction operations.
B. Provide special protection where specified in individual specification sections.
C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
G. Prohibit traffic from landscaped areas.
H. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP
A. Coordinate schedule for start-up of various equipment and systems.
B. Notify Architect and owner three days prior to start-up of each item.
C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
E. Verify that wiring and support components for equipment are complete and tested.
F. Execute start-up under supervision of applicable Contractor personnel in accordance with manufacturers' instructions.
G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
H. Submit a written report that equipment or system has been properly installed and is functioning correctly.
3.11 DEMONSTRATION AND INSTRUCTION
   A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
   B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
   C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.
   D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
   E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

3.12 ADJUSTING
   A. Adjust operating products and equipment to ensure smooth and unhindered operation.
   B. Testing, adjusting, and balancing HVAC systems: See Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

3.13 FINAL CLEANING
   A. Execute final cleaning prior to final project assessment.
      1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
   B. Use cleaning materials that are nonhazardous.
   C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
   D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
   E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
   F. Replace filters of operating equipment.
   G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
   H. Clean site; sweep paved areas, rake clean landscaped surfaces.
   I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES
   A. Make submittals that are required by governing or other authorities.
      1. Provide copies to Architect and Owner.
   B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
   C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
   D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
   E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

END OF SECTION
SECTION 01 7800 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Project Record Documents.
   B. Operation and Maintenance Data.
   C. Warranties and bonds.

1.02 RELATED REQUIREMENTS
   A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
   B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.
   C. Individual Product Sections: Specific requirements for operation and maintenance data.
   D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS
   A. Project Record Documents: Submit documents to Architect before final application for payment.
   B. Operation and Maintenance Data:
      1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
      2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
      3. Submit one copy of completed documents 7 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
      4. Submit two sets of revised final documents in final form within 10 days after final inspection.
   C. Warranties and Bonds:
      1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
      2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
      3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS
   A. Maintain on site one set of the following record documents; record actual revisions to the Work:
      1. Drawings.
      2. Specifications.
      3. Addenda.
      4. Change Orders and other modifications to the Contract.
      5. Reviewed shop drawings, product data, and samples.
      6. Manufacturer's instruction for assembly, installation, and adjusting.
   B. Ensure entries are complete and accurate, enabling future reference by Owner.
   C. Store record documents separate from documents used for construction.
   D. Record information concurrent with construction progress.
   E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA
A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES
A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS
A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.
B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
E. Provide servicing and lubrication schedule, and list of lubricants required.
F. Include manufacturer's printed operation and maintenance instructions.
G. Include sequence of operation by controls manufacturer.
H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
I. Provide control diagrams by controls manufacturer as installed.
J. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
K. Include test and balancing reports.
L. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner’s personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 3 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
J. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Operation and maintenance data.
      c. Field quality control data.
      d. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
B. Verify that documents are in proper form, contain full information, and are notarized.
C. Co-execute submittals when required.
D. Retain warranties and bonds until time specified for submittal.
E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION
SECTION 02 4100 - DEMOLITION

PART 1  GENERAL

1.01  SECTION INCLUDES

A.  Selective demolition of built site elements.
B.  Selective demolition of building elements for alteration purposes.

1.02  RELATED REQUIREMENTS

A.  Section 01 1000 - Summary:  Limitations on Contractor's use of site and premises.
B.  Section 01 1000 - Summary:  Sequencing and staging requirements.
C.  Section 01 5000 - Temporary Facilities and Controls:  Site fences, security, protective barriers, and waste removal.
D.  Section 01 5713 - Temporary Erosion and Sediment Control.
E.  Section 01 6000 - Product Requirements:  Handling and storage of items removed for salvage and relocation.
F.  Section 01 7000 - Execution and Closeout Requirements:  Project conditions; protection of benchmarks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

1.03  REFERENCE STANDARDS

1.04  SUBMITTALS

A.  See Section 01 3000 - Administrative Requirements, for submittal procedures.
B.  Site Plan:  Showing:
   1.  Vegetation to be protected.
   2.  Areas for temporary construction and field offices.
   3.  Areas for temporary and permanent placement of removed materials.
C.  Project Record Documents:  Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2  PRODUCTS -- NOT USED

PART 3  EXECUTION

3.01  SCOPE

A.  Remove portions of existing buildings in the following sequence:
   1.  Wall caps.
   2.  Aluminum storefront system; salvage components for reuse.
   3.  Head wall and portion of roof structure.
B.  Remove paving and curbs as required to accomplish new work.
C.  Remove other items indicated, for salvage, relocation, recycling, and reuse.

3.02  GENERAL PROCEDURES AND PROJECT CONDITIONS

A.  Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1.  Obtain required permits.
   2.  Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3.  Provide, erect, and maintain temporary barriers and security devices.
   4.  Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   5.  Conduct operations to minimize effects on and interference with adjacent structures and occupants.
6. Do not close or obstruct roadways or sidewalks without permit or Owner’s written permission.
7. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

D. Protect existing roof membrane. Move existing rock ballast from area of new construction. Cover ballast with tarp under 3/4 inch plywood. Prevent foreign matter from contaminating existing ballast. If ballast becomes contaminated it shall be removed from roof and washed clean and put back into place or replaced with new ballast.

E. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Separate areas in which demolition is being conducted from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.
   2. Provide, erect, and maintain temporary exit barriers of construction specified in Section 01 5000 where dead end corridors would be created if exit passage is blocked.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Verify that abandoned services serve only abandoned facilities before removal.
   3. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.04 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.
C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION
SECTION 03 0516 - UNDERSLAB VAPOR BARRIER

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS
A. Section 03 3000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS
A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.
B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers’ data on manufactured products.
C. Samples: Submit samples of underslab vapor barrier to be used.

PART 2 PRODUCTS

2.01 MATERIALS
A. Underslab Vapor Barrier:
   1. Water Vapor Permeance: Not more than 0.018 perms, maximum.
   2. Thickness: 15 mils.
   3. Products:
      e. Substitutions: See Section 01 6000 - Product Requirements.
B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 INSTALLATION
A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
C. Lap joints minimum 6 inches.
D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION
SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.
B. Floors and slabs on grade.
C. Concrete foundation walls.
D. Concrete reinforcement.
E. Joint devices associated with concrete work.
F. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 03 0505 - Underslab Vapor Barrier: Underslab vapor barrier.
B. Section 03 3511 - Concrete Floor Finishes: Densifiers and hardeners.
C. Section 07 9200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

1.03 REFERENCE STANDARDS

A. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
B. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
D. ACI 305R - Hot Weather Concreting; 2010.
E. ACI 306R - Cold Weather Concreting; 2010.
F. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).
G. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
Q. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers’ data on manufactured products showing compliance with specified requirements and installation instructions.
C. Mix Design: Submit proposed concrete mix designs for each concrete mix design indicated on drawings.
   1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
D. Steel Reinforcement Shop Drawings:
   1. Placing drawings that detail fabrication, bending and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, tie spacing and supports for concrete reinforcement.
E. Construction Joint Layout:
   1. Indicate proposed construction joints in slab-on-grade construction. Joint layout is subject to the approval of the Architect.
F. Test Reports: Submit report for each test or series of tests specified.

1.05 QUALITY ASSURANCE
A. Perform work of this section in accordance with ACI 301 and ACI 318.
B. Follow recommendations of ACI 305R when concreting during hot weather.
C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK
A. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Coating: Release agent that will not adversely affect concrete.
   2. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT MATERIALS
A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
   1. Type: Deformed billet-steel bars.
B. Steel Welded Wire Reinforcement (WWR): Plain type, ASTM A1064/A1064M.
   1. WWR Style: As indicated on drawings.
C. Reinforcement Accessories:

2.03 CONCRETE MATERIALS
A. Cement: ASTM C150/C150M, Type I/II Portland type.
B. Fine and Coarse Aggregates: ASTM C33/C33M.
C. Fly Ash: ASTM C618, Class C or F.
D. Water: ASTM C94, Clean and not detrimental to concrete.

2.04 ADMIXTURES
A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
B. Air Entrainment Admixture: ASTM C260/C260M.
2.05 ACCESSORY MATERIALS

A. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107/C1107M.
   2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
   3. Low-Slump, Dry Pack Products:
      b. The QUIKRETE Companies; QUIKRETE® FastSet™ Non-Shrink Grout: www.quikrete.com/#sle.

2.06 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
B. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.

2.07 CURING MATERIALS

   1. Application: Use at floors with carpet finish.
   2. Manufacturers:
      e. Substitutions: See Section 01 6000 - Product Requirements.

B. Curing and Sealing Compound, Gloss: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C1315 Type 1 Class A.
   1. Application: Use at floors with exposed concrete and densifier/hardener.
   4. Manufacturers:
      a. Dayton Superior Corporation; Cure & Seal 1315 EF: www.daytonsuperior.com/#sle.
      f. Substitutions: See Section 01 6000 - Product Requirements.

C. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

A. Prepare mix designs for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data according to ACI 301.
B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
D. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
3. Water-Cement Ratio: As indicated on drawings.
4. Total Air Content: As indicated on drawings.
5. Maximum Slump: As indicated on drawings.

2.09 MIXING
A. Transit Mixers: Comply with ASTM C94/C94M.
B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION
A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
B. Verify that forms are clean and free of rust before applying release agent.
C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
   1. Use latex bonding agent only for non-load-bearing applications.
E. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
   1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS
A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.
C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE
A. Place concrete in accordance with ACI 304R.
B. Place concrete for floor slabs in accordance with ACI 302.1R.
C. Notify Architect not less than 24 hours prior to commencement of placement operations.
D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
E. Ensure reinforcement, inserts, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing...
laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING
A. Locate joints as indicated on the approved Construction Joint layout submittal.
B. Anchor joint fillers and devices to prevent movement during concrete placement.
C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
   1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES
A. Maximum Variation of Surface Flatness:
   1. Exposed Concrete Floors: 1/4 inch in 10 feet.
   2. Under Carpeting: 1/4 inch in 10 feet.
B. Correct the slab surface if tolerances are less than specified.
C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE FINISHING
A. Repair surface defects, including tie holes, immediately after removing formwork.
B. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
   1. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting.
   2. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; decorative exposed surfaces include surfaces to receive liquid hardeners.
   3. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.
C. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.08 CURING AND PROTECTION
A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.
C. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer’s satisfaction.
   2. Curing: Begin after application of densifier/hardener with subsequent water cleaning and before surface is dry.
      a. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.
3.09 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
B. Provide free access to concrete operations at project site and cooperate with appointed firm.
C. Submit proposed mix design of each class of concrete to testing firm for review prior to commencement of concrete operations.
D. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 15 cubic yards or less of Mix ID 1 and Mix ID 2 concrete, as indicated on drawings.
E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.10 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

3.11 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION
SECTION 03 3511 - CONCRETE FLOOR FINISHES

PART 1  GENERAL
1.01 SECTION INCLUDES
   A. Surface treatments for concrete floors and slabs.

1.02 RELATED REQUIREMENTS
   A. Section 03 3000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.03 ADMINISTRATIVE REQUIREMENTS
   A. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.06 FIELD CONDITIONS
   A. Do not finish floors until interior heating system is operational.
   B. Maintain ambient temperature of 50 degrees F minimum.

PART 2  PRODUCTS
2.01 CONCRETE FLOOR FINISH APPLICATIONS
   A. Liquid Densifier/Hardener:
      1. Use at following locations: exposed concrete floor slabs.

2.02 DENSIFIERS AND HARDENERS
   A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
      1. Composition: Lithium silicate.
      2. Products:
         f. Substitutions: See Section 01 6000 - Product Requirements.

2.03 COATINGS
   A. Transparent Sealer: High gloss acrylic.
      1. 2 coats sealer.
      2. Sealer Product:
         b. Diversey Inc.; Ironstone.
         c. SC Johnson Professional; High Gloss Floor Finish.
         d. Substitutions: See Section 01 6000 - Product Requirements.

PART 3  EXECUTION
3.01 EXAMINATION
   A. Verify that floor surfaces are acceptable to receive the work of this section.
B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL
A. Apply densifier/hardener materials using spray methods in accordance with manufacturer's instructions.

3.03 DENSIFIER/HARDENERS AND COATING APPLICATION
A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
C. Apply floor sealer with mop per manufacturer's instructions. Apply specified number of coats with subsequent coats mopped perpendicular to previous coat.
D. Allow floor sealer to dry 24 hours. Burnish final coat with powered rotating pad floor machine using fine textured buffer pad.

3.04 PROTECTION
A. Protect finished coatings until completion of project.
B. Touch-up damaged coatings after Substantial Completion.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Concrete Block.
   B. Mortar.
   C. Reinforcement and Anchorage.
   D. Flexible Flashing.
   E. Installation of Lintels.
   F. Accessories.

1.02 RELATED REQUIREMENTS
   A. Section 05 5000 - Metal Fabrications: Loose steel lintels.
   B. Section 07 2100 - Thermal Insulation: Sheathing for walls and installation.
   C. Section 07 6200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
   D. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and weeps and flashing.
   C. Samples: Submit two samples of regular smooth face concrete block units to illustrate color, texture, and extremes of color range.
   D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

1.05 QUALITY ASSURANCE
   A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.
   B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum five years of experience.
   C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of experience.
1.06 DELIVERY, STORAGE, AND HANDLING
   A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.07 FIELD CONDITIONS
   A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS
   A. Concrete Block: Comply with referenced standards and as follows:
      1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth of 4 inches.
      2. Special Shapes: Provide non-standard blocks configured for corners, control joint edges, and sills.
      3. Face Type: Regular smooth face, with color variations as indicated on Drawings for specific locations.
         a. Both hollow and solid block, as indicated.
         b. Lightweight.
      6. Color and texture shall match existing building masonry units.
   B. Admixture: Integral water repellent.
      1. Manufacturers:
         b. BASF, Master Builders Solutions; MasterPel 240:
            master-builders-solutions.basf.us/en-us.
         e. Substitutions: See section 01 6000 - Product Requirements.

2.02 MORTAR MATERIALS
   A. Masonry Cement: ASTM C91/C91M Type N.
   B. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
      1. Color(s): Match existing.
      2. Manufacturers:
         d. Substitutions: See Section 01 6000 - Product Requirements.
   C. Water: Clean and potable.
   D. Accelerating Admixture: Nonchloride type for use in cold weather.
   E. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.
      1. Manufacturers:
         b. BASF, Master Builders Solutions; MasterPel 240MA:
         e. W. R. Grace & Co.; DRY-BLOCK and DRY-BRICK Mortar Admixture:
2.03 REINFORCEMENT AND ANCHORAGE

A. Joint Reinforcement: Truss type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

B. Masonry Veneer Anchors: Barrel style screw with additional plastic prong washer or integral washer of 1 1/2 inch minimum diameter, plus thermal break wire tie holder.

   1. Shank: Use appropriate screw for wall backup material and length appropriate for rigid board insulation or sheathing thickness.
      a. Use self-drilling screw shank at steel stud backup.

   2. Wire Tie: 3/16 inch diameter cold-drawn steel, ASTM A1054/A1054M with hot-dip galvanized finish, ASTM A153/A153M.

   3. Products: Combination of tie and washer products.
      c. Substitutions: See Section 01 6000 - Product Requirements.

2.04 FLASHINGS

A. Metal Flashing Materials: Materials as specified in Section 07 6200.

B. Flexible Flashing: Polyethylene laminate membrane with factory applied non-asphaltic adhesive covered with a release sheet, 30 mil thick minimum.

   1. Manufacturers:

2.05 ACCESSORIES

A. Joint Filler: Closed cell neoprene; oversized 50 percent to joint width; self expanding; 3 inch wide by maximum lengths available.

   1. Manufacturers:
      b. WIRE-BOND; Vertical Expansion Joint #3300: www.wirebond.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.

B. Building Paper: ASTM D226/D226M, Type I ("No. 15") asphalt felt.

C. Weeps: Polyester mesh.

   1. Manufacturers:
      b. Mortar Net Solutions; WeepVent: www.mortarnet.com

D. Cavity Vents: Polyester mesh.

   1. Manufacturers:
      b. Mortar Net Solutions; Weep Vent: www.mortarnet.com
      c. Substitutions: See Section 01 6000 - Product Requirements.

E. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh, dovetail shape panels, 90 percent open weave, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.

   1. Mortar Diverter: Panels installed at flashing locations.
      a. Manufacturers:
         3) Substitutions: See Section 01 6000 - Product Requirements.
F. Termination Bars: Stainless steel; compatible with membrane and adhesives.
G. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.06 MORTAR MIXES
   1. Exterior, non-loadbearing masonry; Type N.
B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
C. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that field conditions are acceptable and are ready to receive masonry.
B. Verify that related items provided under other sections are properly sized and located.
C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 COURSING
A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
C. Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave to match existing.

3.03 PLACING AND BONDING
A. Lay hollow masonry units with face shell bedding on head and bed joints.
B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
C. Remove excess mortar as work progresses.
D. Interlock intersections and external corners.
E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.04 WEEPS/CAVITY VENTS
A. Install weeps in veneer walls at 32 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
B. Install cavity vents in veneer walls at 32 inches on center horizontally below shelf angles and lintels and at top of walls.

3.05 CAVITY MORTAR CONTROL
A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.06 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER
A. Install horizontal joint reinforcement 16 inches on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
C. Place masonry joint reinforcement in first horizontal joint above and below horizontal bond breakers.
D. Place continuous joint reinforcement in first and second joint below top of walls.
E. Lap joint reinforcement ends minimum 6 inches.
F. Stud Back-Up: Secure veneer anchors through rigid insulation to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center. Place additional anchors above and below and beside horizontal bond breakers and vertical control or expansion joints.

3.07 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Remove or cover protrusions or sharp edges that could puncture flashings.
   2. Seal lapped ends and penetrations of flashing before covering with mortar.
B. Extend metal flashings through exterior face of masonry and turn down to form drip.
C. Fasten metal flashings to sheathing with butyl tape and termination bar and cover joint with flashing tape. See Section 07 2100 Thermal Insulation.
D. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.08 LINTELS

A. Install loose steel lintels over openings.
B. Maintain minimum 6 inch bearing on each side of opening.

3.09 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.
B. Set jamb block at control joint locations where shown on Drawings.
C. Make control joint minimum 1/2 inch width and fill with specified control joint filler allowing space for surface sealant.
D. Seal control joint surface per Section 07 9200 Joint Sealants.
E. Size expansion joints and locate as detailed on Drawings.
F. Install preformed expansion joint devices in continuous length. Seal top and bottom of joint in accordance with manufacturer’s instructions.

3.10 TOLERANCES

A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/8 inch, plus 1/8 inch.

3.11 CUTTING AND FITTING

A. Cut and fit for openings. Coordinate with other sections of work to provide correct size, shape, and location.
B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 CLEANING

A. Remove excess mortar and mortar smears as work progresses.
B. Replace defective mortar. Match adjacent work.
C. Clean soiled surfaces with cleaning solution.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Structural steel framing members, support members.
   B. Base plates, and anchor bolts.
   C. Grouting under base plates.

1.02 RELATED REQUIREMENTS
   A. Section 03 3000 - Cast-in-Place Concrete - Grout for bearing plates.
   B. Section 05 3100 - Steel Decking: Support framing for small openings in deck.
   C. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 REFERENCE STANDARDS
   G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
   J. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.
   N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
   P. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2009.
   Q. SSPC-SP 3 - Power Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings:
      1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
      2. Connections.
      3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
C. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE
A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
B. Structural steel members designated as architecturally-exposed structural steel (AESS) to also comply with Section 05 1213.
C. Fabricator: Company specializing in performing the work of this section with minimum five years of experience.
D. Erector: Company specializing in performing the work of this section with minimum five years of experience.

PART 2 PRODUCTS
2.01 MATERIALS
A. Steel Angles, Plates, and Rods: ASTM A36/A36M.
B. Steel W Shapes and Tees: ASTM A992/A992M.
C. Rolled Steel Structural Shapes: ASTM A992/A992M.
D. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
E. Steel Plate: ASTM A514/A514M.
F. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M, Class C.
G. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
H. Headed Anchor Rods: ASTM F1554, Grade 55, plain.
I. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
J. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION
A. Shop fabricate to greatest extent possible.
B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
C. Fabricate connections for bolt, nut, and washer connectors.

2.03 FINISH
A. Prepare structural component surfaces in accordance with SSPC-SP 3.
B. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete, or high strength bolted.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION
A. Erect structural steel in compliance with AISC 303.
B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
C. Field weld components indicated on shop drawings.
D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
E. Do not field cut or alter structural members without approval of Architect.
F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES
A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION
SECTION 05 3100 - STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof deck.
B. Supplementary framing for openings up to and including 18 inches.
C. Bearing plates and angles.

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing: Support framing for openings larger than 18 inches.

1.03 REFERENCE STANDARDS

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
F. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2006.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
B. Shop Drawings: Indicate deck plan, support locations, projections, openings, pertinent details, accessories, and connections.
C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this Section with minimum five years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Cut plastic wrap to encourage ventilation.
B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Deck:

2.02 STEEL DECK

A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
1. Calculate to structural working stress design and structural properties specified.

B. Roof Deck: Non-composite type, fluted steel sheet:
2. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
3. Structural Properties:
   a. Section Modulus: 0.659.
   b. Span Design: Double.
4. Minimum Base Metal Thickness: 19 gage, 0.0418 inch.
5. Nominal Height: 3 inch.
6. Profile: Fluted; SDI As indicated on drawings.
7. Formed Sheet Width: 24 inch.
8. Side Joints: Attach to supporting structure as indicated on drawings.

2.03 ACCESSORY MATERIALS
A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
B. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.
C. Welding Materials: AWS D1.1/D1.1M.
D. Fasteners: Galvanized hardened steel, self tapping.
E. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.
   1. Design Requirements for Sidelap Connections: Provide number and type of fasteners that comply with the applicable requirements of SDI (DM)SDI design method for roof deck and floor deck applications, ICC-ES AC43, and FM DS 1-28/FM DS 1-29 wind uplift resistance.
   2. Fasteners for Exposed Steel Roof Deck Application: Manufacturer's standard stainless steel with bonded neoprene washer.
F. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
H. Flute Closures: Closed cell neoprene, 1 inch wide; profiled to fit tight to the deck.

2.04 FABRICATED DECK ACCESSORIES
A. Sheet Metal Deck Accessories: Metal closure strips and cover plates, 20 gage, 0.0359 inch thick sheet steel; of profile and size as indicated; finished same as deck.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION
A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
B. On steel supports provide minimum 1-1/2 inch bearing.
C. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using methods indicated on drawings.
D. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.
E. Weld deck in accordance with AWS D1.3/D1.3M.
F. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

G. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION
SECTION 05 4000 - COLD-FORMED METAL FRAMING

PART 1  GENERAL

1.01  SECTION INCLUDES
   A.  Formed steel stud exterior wall framing.

1.02  RELATED REQUIREMENTS
   A.  Section 06 1000 - Rough Carpentry:  Wood blocking and miscellaneous framing.
   B.  Section 06 1000 - Rough Carpentry:  Wall sheathing.
   C.  Section 07 2100 - Thermal Insulation:  Insulation within framing members.
   D.  Section 07 2500 - Weather Barriers:  Weather barrier over sheathing.
   E.  Section 09 2116 - Gypsum Board Assemblies:  Lightweight, non-load bearing metal stud framing.

1.03  REFERENCE STANDARDS
   A.  AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
   C.  ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process; 2015.
   E.  ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2015.
   G.  PS 1 - Structural Plywood; 2009.

1.04  ADMINISTRATIVE REQUIREMENTS
   A.  Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.05  SUBMITTALS
   A.  See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B.  Product Data:  Provide data on standard framing members; describe materials and finish, product criteria, limitations.
   C.  Product Data:  Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
   D.  Manufacturer's Installation Instructions:  Indicate special procedures, conditions requiring special attention, and intended fastening methods.

1.06  QUALITY ASSURANCE
   A.  Designer Qualifications:  Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Wyoming.
   B.  Installer Qualifications:  Company specializing in performing the work of this section with minimum three years experience.
PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Metal Framing:
B. Framing Connectors and Accessories:
   1. Same manufacturer as metal framing.

2.02 FRAMING SYSTEM
A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
B. Design Requirements: Provide completed framing system having the following characteristics:
   1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100-12.
   2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
   3. Design Loads: In accordance with applicable codes.
   4. Live load deflection meeting the following, unless otherwise indicated:
      a. Exterior Walls: Maximum horizontal deflection under wind load of 1/180 of span.
      b. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.
   5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 FRAMING MATERIALS
A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
   1. Gage and Depth: As indicated on drawings.
   2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
B. Framing Connectors: Factory-made, formed steel sheet.
   1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch, and factory punched holes and slots unless noted otherwise on drawings.
   2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.

2.04 WALL SHEATHING
A. See Section 06 1000 Rough Carpentry for product.

2.05 ACCESSORIES
A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
2.06 FASTENERS
   A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
      1. Size and Length appropriate for application and substrate.
   B. Anchorage Devices: As indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION OF STUDS
   A. Install components in accordance with manufacturers’ instructions and ASTM C1007 requirements.
   B. Place studs at 16 inches on center, not more than 2 inches from abutting walls.
   C. Construct jambs and headers at openings as indicated on Drawings.
   D. Construct corners using minimum of three studs.
   E. Install studs full length in one piece. Splicing of studs is not permitted.
   F. Coordinate placement of insulation in multiple stud spaces and headers made inaccessible after erection.
   G. Install intermediate studs above and below openings to align with wall stud spacing.
   H. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
   I. Touch-up damaged galvanized surfaces with primer.

3.03 INSTALLATION OF WALL SHEATHING
   A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
      1. Provide boundary and field attachment to metal framing as indicated on drawings.

END OF SECTION
SECTION 05 5000 - METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Shop fabricated steel items.

1.02 RELATED REQUIREMENTS
A. Section 04 2001 - Masonry Veneer: Placement of metal fabrications in masonry.
B. Section 09 9113 - Exterior Painting: Paint finish.

1.03 REFERENCE STANDARDS
E. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014.
F. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.
G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
I. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE
A. Design structural components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Wyoming.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL
A. Steel Sections: ASTM A36/A36M.
B. Plates: ASTM A283/A283M.
C. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
D. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION
A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS
A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
B. lintels: As detailed; prime paint finish.
C. Glulam Beam Connections: prime paint finish, field paint finish.

2.04 FINISHES - STEEL
A. Prime paint steel items.
B. Prepare surfaces to be primed in accordance with SSPC-SP2.
C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
D. Prime Painting: One coat.

2.05 FABRICATION TOLERANCES
A. Squareness: 1/8 inch maximum difference in diagonal measurements.
B. Maximum Offset Between Faces: 1/16 inch.
C. Maximum Misalignment of Adjacent Members: 1/16 inch.
D. Maximum Bow: 1/8 inch in 48 inches.
E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION
A. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION
A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Field weld components as indicated on drawings.
D. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Obtain approval prior to site cutting or making adjustments not scheduled.
F. After erection, prime welds, abrasions, and surfaces not shop primed.

3.04 TOLERANCES
A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION
SECTION 05 7500 - DECORATIVE FORMED METAL

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Interior and exterior fabrications made of formed metal sheet, secondary supports, and anchors to structure, including:
      1. Fascia cover.

1.02 RELATED REQUIREMENTS
   A. Section 07 6200 - Sheet Metal Flashing and Trim: Formed metal flashings and trim.
   B. Section 09 9123 - Interior Painting.

1.03 REFERENCE STANDARDS
   G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
   H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data - Sheet Metal Material: Manufacturer’s data sheets on each product to be used, including:
      1. Preparation instructions and recommendations.
      2. Storage and handling requirements and recommendations.
      3. Installation methods.
   C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
      1. Show actual field measurements on shop drawings.
      2. Differentiate between shop and field fabrication.
      3. Indicate substrates and adjacent work with which the fabrications must be coordinated.
      4. Include large-scale details of anchorages and connecting elements.
      5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain product shapes at a scale of not less than 1-1/2 inches per 12 inches.
D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product in color and texture.

F. Installer's Qualification Statement.

G. Maintenance Data: Care of finishes and warranty requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Protect finishes by applying heavy duty removable plastic film during production.
   2. Package for protection against transportation damage.
   3. Provide markings to identify components consistently with drawings.
   4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well ventilated space out of direct sunlight.
   2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
   3. Store at a slope to ensure positive drainage of any accumulated water.
   4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F.
   5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

PART 2 PRODUCTS

2.01 FORMED METAL FABRICATIONS - GENERAL

A. Shop Assembly: Preassemble items to greatest extent possible. Minimize field splices and field assembly. Disassemble only as necessary for transportation and handling. Mark items clearly for assembly and installation.

B. Coordination: Match dimensions and attachment of formed metal items to adjacent construction. Coordinate with roof edge flashing. Produce integrated assemblies. Closely fit joints; align edges and flat surfaces unless indicated otherwise.

C. Forming: Profiles indicated. Maximize lengths. Fold exposed edges to form hem indicated or ease edges to radius indicated with concealed stiffener. Provide flat, flush surfaces without cracking or grain separation at bends.

D. Reinforcement: Increase metal thickness; use concealed stiffeners, backing materials or both. Provide stretcher leveled standard of flatness and stiffness required to maintain flatness and hold adjacent items in flush alignment.

E. Anchors: Straps, plates and anchors as required to support and anchor items to adjacent construction.

F. Supports: Miscellaneous framing, mounting, clips, sleeves, fasteners and accessories required for installation.

G. Performance Requirements:
   1. Thermal Movements:
      a. Allow for thermal movements in exterior metal fabrications due to temperature changes. Prevent buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
      b. Temperature Change Range: 120 degrees F, ambient; 180 degrees F, on material surfaces.
2. Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

2.02 FORMED METAL FABRICATIONS - SHEET METAL

A. Closures, Trim and Fill Panels:
   1. Form closures from type and thickness of metal indicated.
   2. Conceal fasteners when possible.
   3. Drill and tap holes for securing to other surfaces.
   4. Miter or cope at corners and reinforce with bent metal plate. Form tight joints.

B. Fascia: Form fascia cladding from galvanized and prefinished metal with minimum 24 gauge (0.0239 inch) base metal thickness. Fit tightly to substrate with drip edge and closures as detailed on Drawings.

2.03 MATERIALS

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections exposed to view on finished units.

B. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating.

C. Steel Sheet: ASTM A1008/A1008M; uncoated, cold rolled, Type CS (commercial steel), exposed.

D. Anchors, Clips and Accessories: Use one of the following:
   2. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A123/A123M Coating Grade 50.

E. Fasteners, General: Same basic metal and alloy as formed metal sheet unless indicated otherwise. Do not use metals incompatible with the materials joined.

F. Joint Sealer: Per Section 07 9200 Joint Sealants.

G. Laminating Adhesive: Recommended by metal fabricator; fully bond metal to metal, prevent telegraphing and oil canning; compatible with substrate; noncombustible after curing. VOC contents calculated according to 40 CFR 59, Subpart D (EPA Method 24) listed below.
   1. Multipurpose Construction Adhesive: 70 g/L or less.

H. Isolation Coating: Manufacturer's standard alkali-resistant coating.

2.04 FINISHES

A. Finishes, General: Comply with NAAMM AMP 500-06.
   1. Complete mechanical finishes before fabrication. After fabrication, finish joints, bends, abrasions and surface blemishes to match sheet.
   2. Protect mechanical finishes on exposed surfaces from damage.
   3. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
   4. Appearance: Limit variations in appearance of adjacent to one-half the range represented in approved samples. Noticeable variations in the same piece are not acceptable. Install components within the range of approved samples to minimize contrast.

B. Galvanized Steel Finishes:
   1. Repair Galvanized Surfaces: Clean welds and abraded areas and repair galvanizing to comply with ASTM A780/A780M.
   2. Superior Performing Organic Coatings: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and interfaces with other work.

B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer’s written instructions.
C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
D. Notify Architect in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

### 3.03 INSTALLATION - SHEET METAL AND PLATE FABRICATIONS

A. Locate and place decorative formed sheet metal items level and plumb; align with adjacent construction. Cut, drill and fit as required to install.
B. Do not cut or abrade sheet metal finishes that cannot be completely restored in the field. Return such items to manufacturer or fabricator for required alterations and refinishing or provide new items.
C. Use concealed anchorages where possible. Provide washers where needed on bolts or screws to protect metal surfaces and make weathertight connection.
D. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers indicated.
E. Install joint fillers, insulation, sealants, and flashings as work progresses.
   1. Make exterior decorative formed sheet metal items weatherproof.
F. Corrosion Protection: Apply permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with incompatible substrate materials. Prevent corrosion damage to material and finish.

### 3.04 CLEANING

A. Restore finishes damaged during installation and construction period. Return items that cannot be refinished in the field to manufacturer or fabricator. Refinish entire unit or provide new units.
B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
C. Remove temporary coverings and protection of adjacent work areas.
D. Clean installed products in accordance with manufacturer's instructions.

### 3.05 PROTECTION

A. Protect installed products from damage during construction.

END OF SECTION
SECTION 06 1000 - ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Wall Sheathing.
   B. Roof-mounted curbs.
   C. Roofing nailers.
   D. Concealed wood blocking, nailers, and supports.
   E. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS
   A. Section 09 2116 - Gypsum Board Assemblies: Wood blocking for supports.

1.03 REFERENCE STANDARDS
   A. PS 1 - Structural Plywood; 2009.
   C. WWPA G-5 - Western Lumber Grading Rules; 2011.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS
   A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
      1. Species: Doug Fir, Western Larch or Hem-Fir, unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS
   A. Grading Agency: Western Wood Products Association; WWPA G-5.
   B. Moisture Content: S-dry or MC19.
   C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
      1. Lumber: S4S, No. 2 or Standard Grade.
      2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS
   A. Wall Sheathing, For walls: Plywood, PS 1, Grade C-D, Exposure I.
      1. Grade: Structural 1 Sheathing.
      2. Performance Category: 5/8 PERF CAT.
      4. Edges: Square.

2.04 ACCESSORIES
   A. Fasteners and Anchors:
      2. Drywall Screws: Bugle head, hardened steel, power driven type, length to achieve full penetration of sheathing substrate.
      3. Anchors: Toggle bolt type for anchorage to hollow masonry.
   B. Construction Adhesives:
      1. Manufacturers:
c. Substitutions: See Section 01 6000 - Product Requirements.

PART 3  EXECUTION

3.01  PREPARATION
   A. Coordinate installation of rough carpentry members specified in other sections.

3.02  INSTALLATION - GENERAL
   A. Select material sizes to minimize waste.
   B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.03  BLOCKING, NAILERS, AND SUPPORTS
   A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
   B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
   C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
   D. Provide the following specific non-structural framing and blocking:
      1. Cabinets and shelf supports.
      2. Wall brackets.
      3. Wall-mounted door stops.
      4. Chalkboards and markerboards.
      5. Pencil Sharpeners.

3.04  ROOF-RELATED CARPENTRY
   A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

3.05  INSTALLATION OF CONSTRUCTION PANELS
   A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing, using screws.
      1. Use plywood at parapet and other walls where roof membrane will be adhered to sheathing.

3.06  CLEANING
   A. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
   B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Glue laminated wood beams.

1.02 RELATED REQUIREMENTS
   A. Section 05 5000 Metal Fabrications: Connections.
   B. Section 09 9113 - Exterior Painting: Field Finishing.
   C. Section 09 9123 - Interior Painting: Field Finishing.

1.03 REFERENCE STANDARDS
   D. WWPA G-5 - Western Lumber Grading Rules; 2011.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide technical data on wood preservative materials, application technique and resultant performance information.
   C. Shop Drawings: Indicate framing system, sizes and spacing of members, and beam radius.

1.05 QUALITY ASSURANCE
   A. Manufacturer/Fabricator Qualifications: Company specializing in manufacture of glue laminated structural units with five years of experience, and certified by AITC in accordance with AITC A190.1.
   B. Erector Qualifications: Company specializing in erection of products of the type specified with three years experience.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Protect members to AITC requirements for individually wrapped.
   B. Leave individual wrapping in place until finishing occurs.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Glue-Laminated Structural Units:
      4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GLUED-LAMINATED UNITS
   A. Glue-Laminated Units: Fabricate in accordance with AITC 117 Architectural grade.
      1. Verify dimensions and site conditions prior to fabrication.
      2. Cut and fit members accurately to length to achieve tight joint fit.
      3. Fabricate member with radius built in.
      4. Do not splice or join members in locations other than those indicated without permission.
      5. After end trimming, seal with penetrating sealer in accordance with AITC requirements.
2.03 MATERIALS
   A. Lumber: Softwood lumber conforming to WWPA G-5 grading rules with 12 percent maximum moisture content before fabrication. Design for the following values:
      1. Bending (Fb): 2400 psi.
      2. Compression Perpendicular to Grain Bottom (Fc1): 650 psi.
      3. Horizontal Shear (Fv): 265 psi.
      5. Lumber fabricated from old growth timber is not permitted.

2.04 FABRICATION
   A. Fabricate glue laminated structural members in accordance with AITC Architectural grade.
   B. Verify dimensions and site conditions prior to fabrication.
   C. Do not splice or join members in locations other than those indicated without permission.
   D. After end trimming, seal with penetrating sealer in accordance with AITC requirements.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that supports are ready to receive units.

3.02 PREPARATION
   A. Coordinate placement of support items.

3.03 ERECTION
   A. Lift members using protective straps to prevent visible damage.
   B. Set structural members level and plumb, in correct positions or sloped where indicated.
   C. Provide temporary bracing and anchorage to hold members in place until permanently secured.
   D. Fit members together accurately without trimming, cutting, splicing, or other unauthorized modification.
   E. Field Finishing: Specified in Section 09 9113 and 09 9123.

3.04 TOLERANCES
   A. Framing Members: 1/2 inch maximum from true position.

END OF SECTION
PART 1 GENERAL

1.01 RELATED REQUIREMENTS
   A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
   B. Section 06 4100 - Plastic Laminate Faced Architectural Wood Casework: Shop fabricated custom cabinet work and countertops.

1.02 REFERENCE STANDARDS
   C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
   E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
   F. PS 1 - Structural Plywood; 2009.

1.03 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements for submittal procedures.
   B. Product Data:
      1. Show material characteristics, physical and performance qualities, finishes and color selections.
   C. Samples: Submit two samples of solid surface material, 3 by 3 inch size, illustrating selected color and sheen.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. Protect work from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS
   A. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

2.02 LUMBER MATERIALS
   A. Softwood Lumber: hem-fir or doug-fir species, plain sawn, maximum moisture content of 6 percent; with flat grain, of quality suitable for transparent finish.

2.03 SHEET MATERIALS
   A. Softwood Plywood Not Exposed to View: Any face species, veneer core; PS 1 Grade A-C; glue type as recommended for application.
   B. Particleboard: ANSI A208.1; Composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.

2.04 PLASTIC LAMINATE MATERIALS
   A. Manufacturers:
      5. Substitutions: See Section 01 6000 - Product Requirements.
   B. Plastic Laminate: NEMA LD 3, HGS; color as selected; satin finish.
C. Laminate Backing Sheet: NEMA LD 3, BKH; undecorated plastic laminate.
D. Laminate Adhesive: Type recommended by laminate manufacturer to suit application; not containing formaldehyde or other volatile organic compounds.

2.05 SOLID SURFACE WINDOW SILL.
A. Flat Sheet Thickness: 3/4 inch, minimum.
B. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA-2 and NEMA LD 3; acrylic resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
   1. Surface Burning Characteristics: Flame spread 25, maximum; smoke developed 450, maximum; when tested in accordance with ASTM E84.
   3. Color and Pattern: As selected by Architect from manufacturer's standard line.
   4. Manufacturers:
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.06 FASTENINGS
A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
B. Concealed Joint Fasteners: Threaded steel.

2.07 ACCESSORIES
A. Lumber for Shimming, Blocking, and Bracing: Softwood lumber of specified species.
B. Plastic Edge Trim: Extruded flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness; color as selected.

2.08 HARDWARE
A. Hardware: Comply with BHMA A156.9.
B. Shelf Standards: double row slot style, satin chrome finish.
C. Shelf Brackets: double row, four slot style, satin chrome finish.

2.09 FABRICATION
A. Shop assemble work for delivery to site, permitting passage through building openings.
B. Fabricate plastic laminate clad shelving with particleboard and plastic laminate on top and bottom surfaces.
C. Cap exposed plastic laminate finish edges with plastic trim.
D. Fabricate solid surface window sills with one continuous single piece. If sill is longer than one single material can cover, a shop fabricated joint is acceptable. Make joint tight and invisible.
E. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
F. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.
G. Apply laminate backing sheet to concealed from view, reverse face of plastic laminate finished surfaces.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify adequacy of backing and support framing.
B. See Section 06 1000 Rough Carpentry for installation of recessed wood blocking.

3.02 INSTALLATION

A. Set and secure materials and components in place, plumb and level.
B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.
C. Install solid surface window sills with full bed of adhesive applied to substrate.

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch.
B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION
SECTION 06 4100 - PLASTIC LAMINATE FACED ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Specially fabricated cabinet units.
   B. Countertops.
   C. Cabinet hardware.

1.02 RELATED REQUIREMENTS
   A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
   B. Section 11 5300 - Laboratory Equipment: Fume hood superstructure, sink and service fittings.

1.03 REFERENCE STANDARDS
   A. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   C. Product Data: Provide data for hardware accessories.
   D. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.05 QUALITY ASSURANCE
   A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Protect units from moisture damage.

1.07 FIELD CONDITIONS
   A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS
   A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) for Custom Grade.
   B. Cabinets at all locations:
      1. Finish - Exposed Exterior Surfaces: High pressure decorative laminate (HPDL).
      2. Finish - Exposed Interior Surfaces: Thermally fused laminate (TPL) or cabinet liner (CLS).
      4. Door and Drawer Front Edge Profiles: PVC extrusion.
      5. Casework Construction Type: Type A - Frameless.
      6. Interface Style for Cabinet and Door: Style 1 - Overlay; reveal overlay.
      7. Adjustable Shelf Loading: 40 lbs. per sq. ft.
         a. Deflection: L/144.
         b. Thickness: 1 inch for shelves over 30 inches span.
      8. Drawer Construction Technique: Dado joints; draw box front with lock rabbet joint and separate front face.
      9. Drawer Box: Thermally fused laminate on fiberboard.
     10. Shelf Quantity: 1 per 10 to 14 inches of vertical case space for base, upper and full height cabinets, unless shown otherwise on Drawings.
2.02 FUME HOODS & CHEMICAL STORAGE CABINETS
A. See Section 11 5300 Laboratory Equipment.

2.03 SHEET MATERIALS
A. Softwood Plywood: Any face species, veneer core; PS 1 Grade A-B; waterproof glue.
B. Particleboard: ANSI A208.1; Industrial Grade (M-3); composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.
C. Fiberboard: ANSI A208.2; composed of cellulosic fibers combined with synthetic resin and joined together under heat and pressure. 49.0 lbs./cu.ft. medium density.
D. Hardboard: ANSI A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch thick, smooth two sides (S2S).

2.04 LAMINATE MATERIALS
A. Manufacturers:
5. Substitutions: See Section 01 6000 - Product Requirements.
B. Thermally Fused Laminate (TFL): Melamine resin, NEMA LD 3, Type VGL laminate panels.
C. High Pressure Decorative Laminate (HPDL): NEMA LD 3.
D. Provide specific types as follows:
1. Horizontal and Vertical Surfaces: HPL (High Pressure Laminate), Chemical Resistant, 0.039 inch nominal thickness, color as selected, manufacturer's standard finish.
2. Cabinet Liner: CLS, 0.020 inch nominal thickness, white color, manufacturer's standard finish.
3. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.05 COUNTERTOPS
A. Plastic Laminate Countertops: Medium density fiberboard substrate, covered with HPDL, conventionally fabricated and self-edge banded.
B. Exposed Edge: Square, substrate built up to minimum 1 1/2 inch thickness, cover with HPDL to match top.
C. Back and End Splashes: Same materials and construction as countertops, 3/4 inch thickness.
D. Aprons: Same materials and construction as countertops, 3/4 inch thickness, HPDL all sides.

2.06 ACCESSORIES
A. Adhesive: Type recommended by AWI/AWMAC to suit application.
B. Sealant: As per Section 07 9200 Joint Sealants.
C. Plastic Edge Banding: Extruded PVC, 3 mm flat shaped with radius edge; smooth finish; of width to match component thickness.
1. Color: As selected by Architect from manufacturer's standard range.
2. Use at exposed door, drawer front and shelf edges.
D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
E. Concealed Joint Fasteners: Threaded steel.
F. Grommets: Standard plastic grommets for cut-outs, in color to blend with adjacent surface.
2.07 HARDWARE
A. Hardware: BHMA A156.9, types as indicated for quality grade specified.
B. Adjustable Shelf Supports: Side mounted, 1/4 inch diameter, twin pins with lock down fins, plastic material.
   1. Products:
      b. Substitutions: See Section 01 6000 - Product Requirements.
C. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers.
D. Door Restraints: Curved lever restraint with mounting plates allowing various degrees of swing.
E. Cabinet Locks: Keyed cylinder, two keys per lock, five pin, master keyed, steel with satin finish.
F. Catches: Magnetic with adjustable body, minimum 5 pound holding force.
G. Drawer Slides: General use.
   1. Type: Full extension, captive nylon rollers.
   2. Static Load Capacity: 100 lbs.
   3. Mounting: Bottom or side.
   4. Stops: Integral type.
   5. Features: Provide self closing/stay closed type.
   7. Manufacturers:
      d. Substitutions: See Section 01 6000 - Product Requirements.
H. Hinges: 5 knuckle institutional hinge with hospital tips semi-concealed type, BHMA 156.9 Grade 1, steel with satin finish.
   1. Manufacturers:
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.08 FABRICATION
A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 3 feet from sink cut-outs.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
E. Door Restraints: Install where swing of door will strike adjacent cabinets, countertops, walls or other building components.
F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Seal cut edges.

2.09 COUNTERTOP FABRICATION
A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches, unless otherwise indicated.

PART 3  EXECUTION

3.01  EXAMINATION
   A. Verify adequacy of backing and support framing.

3.02  INSTALLATION
   A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
   B. Use concealed joint fasteners to align and secure adjoining cabinet units.
   C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
   D. Install filler panels to close gaps at adjacent walls.
   E. Secure cabinets to floor using appropriate angles and anchorages.
   F. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
   G. Seal joints between countertops, back/end splashes and vertical surfaces.

3.03  ADJUSTING
   A. Adjust moving or operating parts to function smoothly and correctly.

3.04  CLEANING
   A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

3.05  PROTECTION
   A. Protect installed products until completion of project.
   B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
SECTION 06 8316 - FIBERGLASS REINFORCED PANELING

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Fiberglass reinforced plastic panels.
   B. Trim.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
   C. Samples: Submit two samples 3 by 3 inch in size illustrating material and surface design of panels.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS
2.01 MANUFACTURERS
   A. Fiberglass Reinforced Plastic Panels:
      4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS
   A. Wall Panels at Classroom (Wet Lab) where shown on Drawings:
      1. Panel Size: 4 by 8 feet.
      2. Panel Thickness: 0.09 inch.
      5. Attachment Method: Adhesive bond, sealant at joints, trim at exposed top and side edges.

2.03 MATERIALS
   A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
      1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
   B. Trim: Vinyl; color coordinating with panel.
   C. Adhesive: Type recommended by panel manufacturer.
   D. Sealant: Silicone; clear.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify existing conditions and substrate flatness before starting work.
   B. Verify that substrate conditions are ready to receive the work of this section.
3.02 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.
B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
E. Install panels with manufacturer's recommended gap for panel field and corner joints.
F. Place trim on panel before fastening edges, as required.
G. Fill channels in trim with sealant before attaching to panel.
H. Install trim with adhesive.
I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
J. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION
SECTION 07 1400 - FLUID-APPLIED DAMPPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Fluid applied membrane dampproofing.

1.02 RELATED REQUIREMENTS
   A. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate.

1.03 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data for membrane and patching compound.

1.04 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

1.05 FIELD CONDITIONS
   A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Acrylic Resin Dampproofing Membrane: Water based, liquid applied, monolithic membrane.
      1. Manufacturers, Products: Apply at rate required to provide dampproofing of substrate. Full waterproofing performance is not required.
         d. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ACCESSORIES
   A. Cementitious Patching Compound: Structural repair compound, dry powder mixed with water or premixed.
      4. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of dampproofing system.
   C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of dampproofing materials.
   D. Verify that items that penetrate surfaces to receive dampproofing are securely installed.

3.02 PREPARATION
   A. Protect adjacent surfaces not designated to receive dampproofing.
B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions. Vacuum substrate clean.
C. Fill cracks and holes with cementitious patching compound per manufacturer's instructions.

3.03 INSTALLATION
A. Apply dampproofing in accordance with manufacturer's instructions to manufacturer's recommended thickness using an airless sprayer.
B. Extend membrane from bottom of footing to top of wall including concrete exposed above grade.
C. Build thickness to meet manufacturer's installation requirements. Apply extra thickness of dampproofing material at corners, intersections, and angles.
D. Allow membrane to fully cure before commencing backfill operations.
E. Remove protection materials from adjacent materials.

END OF SECTION
SECTION 07 2100 - THERMAL INSULATION

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Board insulation at cavity wall construction, perimeter foundation wall, and exterior wall behind masonry or stucco wall finish.
B. Batt insulation and vapor retarder in exterior wall construction.

1.02  RELATED REQUIREMENTS

A. Section 07 2119 - Foamed-In-Place Insulation: Plastic foam insulation other than boards.
B. Section 07 5323 - Ethylene-Propylene-Diene-Monomer Roofing (EPDM): Insulation specified as part of roofing system.
C. Section 07 5400 - Thermoplastic Membrane Roofing: Insulation specified as part of roofing system.
D. Section 09 2116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03  REFERENCE STANDARDS


1.04  SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.05  FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2  PRODUCTS

2.01  APPLICATIONS

A. Insulation at Perimeter of Foundation: Extruded polystyrene board.
B. Insulation Over Metal Stud Framed Walls, Continuous: Polyisocyanurate board.
C. Insulation in Metal Framed Walls: Batt insulation with separate vapor retarder.

2.02  FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene Board Insulation, for foundation perimeter: Extruded polystyrene board; Type IV, ASTM C578; with natural skin surfaces, and the following characteristics:
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. R-value: 1 inch of material at 72 degrees F: 5, minimum.
   4. Thickness: 2 inches.
   5. Compressive Strength: 25 psi minimum.
   7. Water Absorption, Maximum: 0.3 percent, by volume.
   8. Manufacturers:
c. Kingspan Insulation LLC; GreenGuard XPS TYPE IV 25 PSI: www.trustgreenguard.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.

B. Polyisocyanurate Board Insulation with Facers Both Sides, for exterior walls; Rigid cellular foam, complying with ASTM C1289; Type I, aluminum foil both faces; Class 1, non-reinforced foam core.
1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
3. Complies with fire resistance requirements specified as part of an exterior wall assembly when tested in accordance with NFPA 285.
4. Compressive Strength: 16 psi
5. Board Thickness: 1 inch.
6. R-value; 1 inch of material at 72 degrees F: 6.0, minimum.
8. Manufacturers:
   b. Dow Chemical Co; Thermax Sheathing: www.dow.com.
   e. Substitutions: See Section 01 6000 - Product Requirements.

2.03 BATT INSULATION MATERIALS

A. Mineral Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
3. Manufacturers:
   c. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle.
   d. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES

A. Vapor Retarder Sheet: ASTM D4397 polyethylene film reinforced with a grid pattern of polyester or nylon yarn, clear.
1. Thickness: 6 mil (0.15 mm).
2. Water Vapor Permeance: 0.062 Grains/HR-Sf-in.Hg.
3. Fire Resistance: Class A flame spread rating per ASTM E-84.
4. Products:
   d. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation Joint Tape: Bright aluminum self-adhering type, 3 or 4 inch wide.
1. Manufacturer:
   a. Carlisle Coatings & Waterproofing; Foil-Grip 1402.
   b. Dow Chemical; Thermax Aluminum Foil Tape.
   c. Rmax Inc.; R-Seal 3000 Tape.
   d. Substitutions: See Section 01 6000 - Product Requirements.

C. Flashing Tape: Plastic film facer with butyl rubber adhesive.
1. Manufacturer:
a. Carlisle Coatings & Waterproofing; Aluma-Grip 701.
b. Dow Chemical; Weathermate Straight Flashing.
c. Rmax Inc.; R-Seal 6000.
d. Substitutions: See Section 01 6000 - Product Requirements.

D. Vapor Retarder Tape: Coated polyester or polyethylene film with acrylic or rubber adhesive backing; pressure sensitive.
   1. Products:
      c. Substitutions: See Section 01 6000 - Product Requirements.

E. Vapor Retarder Adhesive: Long open time, allows repositioning of materials.
   1. Products:
      a. 3M; Pressure Sensitive Spray Adhesive 72: www.3m.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

F. Insulation Fasteners: Self tapping screw of galvanized steel with washer retainer and clips, to be mechanically fastened into surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

G. Masonry Veneer Anchors: Anchor washer shall provide positive insulation attachment to wall substrate.
   1. See Section 04 2001 Masonry Veneer for products and installation.

H. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
   B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER
   A. Apply adhesive to back of boards:
      1. Three continuous beads per board length.
   B. Install boards horizontally on foundation perimeter.
      1. Place boards to maximize adhesive contact.
      2. Butt edges and ends tightly to adjacent boards and to protrusions.
   C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT EXTERIOR WALLS
   A. Install system to create continuous thermal and air barrier per manufacturer's instructions.
   B. Apply 1 inch bead of expanding foam insulation along wall sill. Locate foam to engage bottom edge of rigid insulation board.
   C. Install boards vertically on walls.
      1. Place reflective foil face towards exterior air space.
      2. Install in staggered joint pattern.
      3. Butt edges and ends tightly to adjacent boards and to protrusions.
   D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
   E. Secure with screw fasteners to substrate at a frequency as follows:
      1. 4 to 6 per insulation board.
      2. Wall ties or stucco lath system will complete support system. See Section 04 2001 Masonry Veneer for wall ties product and installation requirements. See Section 09 2236.23 Metal Lath for stucco lath system installation requirements.
F. Place 6 inch wide polyethylene sheet at perimeter of wall openings, from interior vapor retarder membrane under window and door frames to exterior air seal. Tape seal in place to ensure continuity of vapor retarder and air seal.

G. Install insulation joint tape over all vertical and horizontal seams; shingle lap joints with 6 inches (152 mm) overlap. If required by insulation manufacturer, apply tape over each wall stud where stucco lath fasteners will be located.

H. Seal joints around penetrations with expanding foam insulation.

I. Install base flashings with butyl tape and termination bar; cover termination bar with flashing tape.

3.04 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall spaces, where shown on Drawings, without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. At metal framing, place vapor retarder on warm side of insulation; Adhere sheet to metal framing with adhesive; lap and seal sheet retarder joints over member face.

F. Tape seal tears or cuts in vapor retarder.

G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

3.05 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION
SECTION 07 2119 - FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foamed-in-place insulation.
   1. In exterior framed walls.
   2. In exterior wall crevices.
   3. At junctions of wall, joists and roof deck materials.
B. Protective intumescent coating.

1.02 REFERENCE STANDARDS


1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than five years of experience.
B. Applicator Qualifications: Company specializing in performing work of the type specified, with minimum three years of experience.

1.05 FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

PART 2 PRODUCTS

2.01 MATERIALS

A. Foamed-In-Place Insulation for cold formed metal framing and metal deck flutes:
   Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
   1. Regulatory Requirements: Conform to applicable code for flame and smoke and overcoat limitations.
   2. Nominal Density: 2.0 pcf in accordance with ASTM D1622.
   3. Thermal Resistance: R-value of 5.0, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518.
   4. Water Vapor Permeance: Vapor retarder; 2 perms, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
   5. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
   6. Air Permeance: 0.04 cfm/sq ft, maximum, when tested at intended thickness in accordance with ASTM E2178 or ASTM E283 at 1.57 psf.
7. Closed Cell Content: At least 90 percent.
8. Surface Burning Characteristics: Flame Spread/Smoke Developed index of 25/450, maximum, when tested in accordance with ASTM E84.
9. Other Acceptable Manufacturers:
   c. Henry Company; PERMAX 2.0: www.henry.com/sle.
   g. Substitutions: See Section 01 6000 - Product Requirements.

B. Expanding Spray Foam Insulation: One component, quick curing, open cell, polyurethane foam, low pressure expansion to fill irregular shape of gaps but not bow window or door frame.
1. Regulatory Requirements: Conform to applicable code for flame and smoke and overcoat limitations.
2. Nominal Density: 1.6 pcf in accordance with ASTM D1622.
3. Surface Burning Characteristics: Flame Spread/Smoke Developed index of 25/450, maximum, when tested in accordance with ASTM E84.
4. Self-contained kit with premixed components.
5. Several dispensing nozzle types for various installations.
6. Manufacturers:
   c. Touch 'n Foam; Window and Door Polyurethane Foam SEALANT: www.touch-n-foam.com.
   d. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ACCESSORIES
A. Primer: As required by insulation manufacturer.
B. Protective Coating: Intumescent coating of type recommended by insulation manufacturer and as required to comply with applicable codes.
   1. Acceptable Products:
      d. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify work within construction spaces or crevices is complete prior to insulation application.
B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 PREPARATION
A. Mask and protect adjacent surfaces from over spray or dusting.

3.03 APPLICATION - COLD FORMED METAL FRAMING AND METAL DECK.
A. Apply insulation in accordance with manufacturer's instructions.
B. Apply insulation by spray method, to a uniform monolithic density without voids.
C. Fill cavity of box headers above wall openings.
D. Apply insulation by spray method with extension tube to fill full length and height of enclosed header cavities without air gaps.
E. Fill voids between metal roof and floor deck flutes above or below metal wall framing and roof framing.

F. Apply overcoat monolithically, without voids to fully cover foam insulation to thickness required by manufacturer creating thermal barrier as required per International Building Code.

G. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.

H. Remove excess material from exterior of metal header, studs and storefront frames.

I. Allow 72 hour curing period before applying wall coatings that will inhibit water vapor transmission.

3.04 APPLICATION - WALL OPENINGS AND PENETRATIONS

A. Install spray foam insulation at all exterior wall insulation system gaps including but not limited to spaces between door or window frames and metal framing, and spaces around wall penetrations.

B. Apply at temperatures above 40 degrees F and below 100 degrees F.

C. Eliminate all sources of fume ignition before installation. Ensure adequate ventilation during installation.

D. Install per manufacturer's instructions.

E. Fill space completely flush to interior and exterior wall framing flanges.

F. Do not overfill space. Allow product expansion to help seal space but, do not allow expansion to bow door or window frame.

G. Allow spray foam insulation to fully cure, then trim excess material flush with metal wall framing.

3.05 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION
SECTION 07 2500 - WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Water-Resistive Barrier: Under exterior wall cladding, over sheathing or other substrate; not air tight or vapor retardant.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on material characteristics and performance criteria.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES
   A. Water-Resistive Barrier: Provide on exterior wall where indicated on Drawings.
      1. Under Portland cement stucco, use two layers of asphalt felt.

2.02 WATER-RESISTIVE BARRIER MATERIALS (NEITHER AIR BARRIER OR VAPOR RETARDER)
   A. Asphalt Felt: ASTM D226/D226M Type I felt (No.15).
   B. Substitutions: Synthetic felt meeting or exceeding specified requirements of asphalt felt.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION
   A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.03 INSTALLATION
   A. Install materials in accordance with manufacturer's instructions.
   B. Water-Resistive Barriers: Install continuous barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.
   C. Mechanically Fastened Sheets - On Exterior:
      1. Install sheets shingle-fashion to shed water, with seams generally horizontal.
      2. Overlap seams as recommended by manufacturer but at least 6 inches.
      3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.
      4. Install water-resistant barrier over base flashings.
      5. Install head flashings over weather barrier.

3.04 FIELD QUALITY CONTROL
   A. See Section 01 4000 - Quality Requirements, for additional requirements.
   B. Coordination of ABAA Tests and Inspections:
      1. Provide testing and inspection required by ABAA QAP.
      2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
      3. Cooperate with ABAA testing agency.
      4. Allow access to air barrier work areas and staging.
      5. Do not cover air barrier work until tested, inspected, and accepted.
   C. Do not cover installed weather barriers until required inspections have been completed.
3.05 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION
SECTION 07 5323 - ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. EPDM membrane roofing system, including all components specified.
B. Comply with the published recommendations and instructions of the roofing membrane manufacturer.
C. Commencement of work by Contractor shall constitute acknowledgement by Contractor that this specification can be satisfactorily executed, under the project conditions and with all necessary prerequisites for warranty acceptance by roofing membrane manufacturer. No modification of the Contract Sum will be made for failure to adequately examine the Contract Documents or the project conditions.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood nailers associated with roofing and roof insulation.
B. Section 07 6200 - Sheet Metal Flashing and Trim: Formed metal flashing, copings and trim items associated with roofing.

1.03 REFERENCE STANDARDS

K. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2006.
L. PS 1 - Structural Plywood; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Before start of roofing work, Contractor shall hold a meeting to discuss the proper installation of materials and requirements to achieve the warranty.
   1. Require attendance with all parties directly influencing the quality of roofing work or affected by the performance of roofing work.
   2. Notify Architect well in advance of meeting.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data:
1. Provide membrane manufacturer’s printed data sufficient to show that all components of roofing system, including insulation and fasteners, comply with the specified requirements and with the membrane manufacturer’s requirements and recommendations for the system type specified; include data for each product used in conjunction with roofing membrane.
   b. Technical data sheets for splice tape and adhesives.
   c. Technical data sheet for batten strips and fasteners.
   d. Technical data sheet for each insulation type.
   e. Technical data sheet for each cover board type.
   f. Technical data sheet for each type of metal edging.
   g. Technical data sheet for walkway pads.
2. Where UL or FM requirements are specified, provide documentation that shows that the roofing system to be installed is UL-Classified or FM-approved, as applicable; include data itemizing the components of the classified or approved system.
3. Installation Instructions: Provide manufacturer's instructions to installer, marked up to show exactly how all components will be installed; where instructions allow installation options, clearly indicate which option will be used.

C. Samples: Submit samples of each product to be used.
   1. Sample of roof membrane.
   2. Sample of batten strips and fasteners.
   3. Sample of walkway pads.
   4. Sample of each insulation type.

D. Shop Drawings: Provide:
   1. The roof membrane manufacturer’s standard details customized for this project for all relevant conditions, including flashings, base tie-ins, roof edges, terminations, expansion joints, penetrations, and drains.
   2. For tapered insulation, provide project-specific layout and dimensions for each board.

E. Specimen Warranty: Submit prior to starting work.

F. Installer Qualifications: Letter from manufacturer attesting that the roofing installer meets the specified qualifications.

G. Pre-Installation Notice: Copy to show that manufacturer’s required Pre Installation Notice (PIN) has been accepted and approved by the manufacturer.

H. Executed Warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed with FM Approvals for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer’s product and that is eligible to receive manufacturer’s special warranty.
   1. At least five years experience in installing specified system.
   2. Due to potential changes and/or directions needed to be conveyed on the job site, contractors shall have at least one foreman/supervisor with the means of communicating verbally in English on-site at ALL TIMES.

C. Source Limitations: Obtain components including roof insulation, cover board, fasteners, and accessories for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.

D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

F. Preinstallation Roofing Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness or curvature and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.
   6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
   7. Review governing regulations and requirements for insurance and certificates if applicable.
   8. Review temporary protection requirements for roofing system during and after installation.
   9. Review roof observation and repair procedures after roofing installation.

1.07 DELIVERY, STORAGE AND HANDLING
   A. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact and legible.
   B. Store materials clear of ground and moisture with weather protective covering.
   C. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
      1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
   D. Keep combustible materials away from ignition sources.
   E. Insulation/Underlayment must be stored so it is kept dry and protected from the elements. Store ALL insulation on a skid and COMPLETELY covered (this means all sides including the top) with a tarpaulin or other suitable waterproof coverings. Weight all insulation down to prevent wind damage.
      1. Slit or remove manufacturer’s packaging before covering with waterproof coverings.
      2. Any insulation NOT COMPLETELY COVERED will be considered damaged and rejected by the Owner for use on the project.
      3. Any rejected materials will be removed from the project IMMEDIATELY and replaced with new material.
   F. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.
   G. When Temperature is expected to fall below 40 degrees F (5 degrees C), outside storage boxes shall be provided on the roof for temporary storage of liquid adhesives, sealants, primers, and Pressure-Sensitive Flashing/Accessories. Containers must be rotated to maintain their temperatures above 40 degrees F (5 degrees C)
   H. Do not store adhesives containers with open lids due to loss of solvent which will occur from flash off.

1.08 PROJECT CONDITIONS
   A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
1.09 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Comply with all warranty procedures required by manufacturer, including notifications, scheduling, and inspections.
C. Warranty: Manufacturer's customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship, for the term indicated.
   1. Twenty (20) Years from Substantial Completion.
   2. Limit of Liability: No dollar limitation.
   3. Warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, roofing accessories, walkway pads, and other components of membrane roofing system.
   4. Scope of Coverage: Repair leaks in the roofing system caused by:
      a. Ordinary wear and tear of the elements.
      b. Manufacturing defect in materials.
      c. Defective workmanship used to install these materials.
      d. Damage due to winds up to 90 mph.
      e. Hail up to 2 inches in diameter.
   5. Not Covered:
      a. Damage due to winds in excess of 90 mph.
      b. Damage due hurricanes or tornadoes.
      c. Intentional damage.
      d. Unintentional damage due to normal rooftop inspections, maintenance, or service.
D. Special Project Warranty: Submit roofing installer's warranty covering Work in this section, including all components of the membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, coverboards, substrate boards, vapor barriers, roof pavers, and walkway products for the following Period:
   1. Two (2) Years from Substantial Completion.

PART 2 PRODUCTS
2.01 MANUFACTURERS
   1. Roofing systems manufactured by others are acceptable provided the roofing system is completely equivalent in materials and warranty conditions and the manufacturer meets the following qualifications:
      a. Specializing in manufacturing the roofing system to be provided.
      b. Minimum ten years of experience manufacturing the roofing system to be provided.
      c. Able to provide a no dollar limit, single source roof system warranty that is backed by corporate assets in excess of one billion dollars.
      d. Able to provide Polyisocyanurate insulation that is produced in own facilities.
      e. Roofing systems manufactured by the companies listed below are acceptable provided they are completely equivalent in materials and warranty conditions:
         1) Carlisle Syntec System.
         2) or approved by Architect.
B. Manufacturer of Insulation: Same manufacturer as roof membrane.
C. Substitutions: See Section 01 6000 - Product Requirements.
   1. Submit evidence that the proposed substitution complies with the specified requirements.

2.02 ROOFING SYSTEM DESCRIPTION
   1. Membrane Attachment: Fully adhered.
   2. Comply with applicable local building code requirements.
4. Provide assembly complying with Factory Mutual Corporation (FM) Roof Assembly Classification, FM DS 1-28 and 1-29, and meeting minimum requirements of FM 1-90 wind uplift rating.

B. Roofing System Components: Listed in order from the top of the roof down:
   1. Membrane: Thickness as specified.
   2. Insulation Cover Board: Gypsum-based board, factory primed, 1/2 inch thick; bead applied adhesive attachment.
   3. Insulation:
      a. Maximum Board Thickness: 3 inches; use as many layers as necessary; stagger joints in adjacent layers.
      b. Tapered: Slope as indicated; provide minimum R-value at thinnest point; place tapered layer on top.
      c. Total R-value: 30, minimum.
      d. Top Layer: Polysocyanurate foam board, non-composite; bead applied adhesive.
      e. Bottom Layer: Polyisocyanurate foam board, non-composite; mechanically fastened.
      f. Tapered Layer: Insulation of same type as specified for top layer; slope as indicated, bead applied adhesive.
   4. Deck Thermal Barrier Board: Gypsum-based board, 1/2 inch thick; loose laid, then mechanically attached with first layer of insulation. May be omitted if insulation is approved for Class A system without thermal barrier over steel deck and meets UL 790 or ASTM E 108.

2.03 EPDM MEMBRANE MATERIALS

A. Roofing and Flashing Membrane: Black, cured synthetic single-ply membrane composed of Ethylene Propylene Diene Monomer (EPDM) with the following properties:
   1. Reinforcement: None; membrane complying with ASTM D4637/D4637M Type I.
   2. Thickness: 0.060 inch.
   4. Sheet Width: Provide the widest available sheets to minimize field seaming.
   5. Seam Type: Factory applied 3 inch wide tape.

B. Membrane Fasteners: Type and size as required by roof membrane manufacturer for roofing system and warranty to be provided; use only fasteners furnished by roof membrane manufacturer.

C. Flashing Membrane: Self-curing, non-reinforced membrane composed of nonvulcanized EPDM rubber, complying with ASTM D4811/D4811M Type II, and with the following properties:
   1. Thickness: 0.060 inch.
   2. Acceptable Product: RubberGard EPDM FormFlash by Firestone or approved membrane manufacturer.

D. Pre-Molded Pipe Flashings: EPDM, molded for quick adaptation to different sized pipes; QuickSeam EPDM Pipe Flashing or approved membrane manufacturer.

E. Self-Adhesive Lap Splice Tape: 35 mil EPDM-based, formulated for compatibility with EPDM membrane and high-solids primer; QuickSeam Splice Tape by Firestone or approved membrane manufacturer.

F. Bonding Adhesive: Neoprene-based, formulated for compatibility with EPDM membrane and wide variety of substrate materials, including masonry, wood, and insulation facings; Bonding Adhesive BA-2004 by Firestone or approved membrane manufacturer.

G. Adhesive Primer: Synthetic rubber based primer formulated for compatibility with EPDM membrane and tape adhesive; QuickPrime Plus by Firestone or approved membrane manufacturer.
H. Seam Edge Treatment: All seam shall be stripped-in with Firestone Quickseam 5” Batten Cover or approved membrane manufacturer.

I. Pourable Sealer: Two-part polyurethane, two-color for reliable mixing; Pourable Sealer by Firestone.

J. Water Block Seal: Butyl rubber sealant for use between two surfaces, not exposed; Water Block Seal by Firestone or approved membrane manufacturer.

K. Metal Plates and Strips Used for Fastening Membrane and Insulation: Steel with Galvalume coating; corrosion-resistance meeting FM 4470 criteria.

L. Termination Bars: Aluminum bars with integral caulk ledge; 1.3 inches wide by 0.10 inch thick; Firestone Termination Bar by Firestone or approved membrane manufacturer.

2.04 ROOF INSULATION AND COVER BOARDS

A. Polyisocyanurate Board Insulation: Closed cell polyisocyanurate foam with black glass reinforced mat laminated to faces, complying with ASTM C1289 Type II Class 1, with the following additional characteristics:
   1. Thickness: As indicated elsewhere.
   2. Size: 48 inches by 96 inches, nominal.
      a. Exception: Insulation to be attached using adhesive or asphalt may be no larger than 48 inches by 48 inches, nominal.
   3. Compressive Strength: 20 psi when tested in accordance with ASTM C1289.
   4. Ozone Depletion Potential: Zero; made without CFC or HCFC blowing agents.
   5. Recycled Content: 19 percent post-consumer and 15 percent pre-consumer (post-industrial), average.

B. Gypsum-Based Cover Board: Non-combustible, water resistant gypsum core with embedded glass mat facers, complying with ASTM C1177/C1177M, and with the following additional characteristics:
   2. Surface Water Absorption: 2.5 g, maximum, when tested in accordance with ASTM C473.
   3. Spanning Capability: Recommended by manufacturer for following minimum flute spans:
      a. 1/2 inch Thickness: 5 inches, minimum.
   4. Surface Burning Characteristics: Flame spread index of 0 (zero), smoke developed index of 0 (zero), when tested in accordance with ASTM E84.
   5. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
   6. Factory Mutual approved for use with rated roofing assemblies.
   7. Mold Growth Resistance: Zero growth, when tested in accordance with ASTM D3273 for minimum of 4 weeks.
   8. Pre-primed for better adhesion.

C. Gypsum-Based Thermal Barrier: Same as Cover Board except without prime surface.

D. Insulation Fasteners: Type and size as required by roof membrane manufacturer for roofing system and warranty to be provided; use only fasteners furnished by roof membrane manufacturer.

E. Adhesive for Insulation Attachment: Type as required by roof membrane manufacturer for roofing system and warranty to be provided; use only adhesives furnished by roof membrane manufacturer.

2.05 METAL ACCESSORIES

A. Metal Parapet Copings, Reglets and Flashing: See Section 07 6200 - Sheet Metal Flashing and Trim.
2.06 ACCESSORY MATERIALS
   A. Wood Nailers: PS 20 dimension lumber, Structural Grade No. 2 or better Hem Fir, Douglas Fir; or PS 1, APA Exterior Grade plywood.
      1. Width: 3-1/2 inches, nominal minimum, or as wide as the nailing flange of the roof accessory to be attached to it.
      2. Thickness: As required.

PART 3 INSTALLATION
3.01 GENERAL
   A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for the specified roofing system. Where manufacturer provides no instructions or recommendations, follow good roofing practices and industry standards. Comply with federal, state, and local regulations.
   B. Obtain all relevant instructions and maintain copies at project site for duration of installation period.
   C. Do not start work until Pre-Installation Notice has been submitted to manufacturer as notification that this project requires a manufacturer's warranty.
   D. Perform work using competent and properly equipped personnel.
   E. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the applicator. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.
   F. Install roofing membrane only when surfaces are clean, dry, smooth and free of snow or ice; do not apply roofing membrane during inclement weather or when ambient conditions will not allow proper application; consult manufacturer for recommended procedures during cold weather. Do not work with sealants and adhesives when material temperature is outside the range of 60 to 80 degrees F.
   G. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
      1. Protect from spills and overspray from adhesives, sealants and coatings.
      2. Particularly protect metal, glass, plastic, and painted surfaces from adhesives, and sealants within the range of wind-borne overspray.
      3. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades.
   H. Until ready for use, keep materials in their original containers as labeled by the manufacturer.
   I. Consult membrane manufacturer's instructions, container labels, and Material Safety Data Sheets (MSDS) for specific safety instructions. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.

3.02 EXAMINATION
   A. Examine roof deck to determine that it is sufficiently rigid to support installers and their mechanical equipment and that deflection will not strain or rupture roof components or deform deck.
   B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.
   C. Examine roof substrate to verify that it is properly sloped to drains.
   D. Verify that the specifications and drawing details are workable and not in conflict with the roofing manufacturer's recommendations and instructions; start of work constitutes acceptable of project conditions and requirements.
3.03 PREPARATION
A. Take appropriate measures to ensure that fumes from adhesive solvents are not drawn into the building through air intakes.
B. Provide a Activated Carbon air filter at all intakes for odor control.
C. Prior to proceeding, prepare roof surface so that it is clean, dry, and smooth, and free of sharp edges, fins, roughened surfaces, loose or foreign materials, oil, grease and other materials that may damage the membrane.
D. Fill all surface voids in the immediate substrate that are greater than 1/4 inch wide with fill material acceptable insulation to membrane manufacturer.
E. Seal, grout, or tape deck joints, where needed, to prevent adhesive seepage into building.
F. Wood Nailers: Provide wood nailers at all perimeters and other locations where indicated on the drawings, of total height matching the total thickness of insulation being used.

3.04 INSULATION AND COVER BOARD INSTALLATION
A. Install insulation in configuration and with attachment method(s) specified in PART 2, under Roofing System.
B. Install only as much insulation as can be covered with the completed roofing system before the end of the day's work or before the onset of inclement weather.
C. Lay roof insulation in courses parallel to roof edges.
D. Neatly and tightly fit insulation to all penetrations, projections, and nailers, with gaps not greater than 1/4 inch. Fill gaps greater than 1/4 inch with acceptable insulation. Do not leave the roofing membrane unsupported over a space greater than 1/4 inch.
E. Mechanical Fastening: Using specified fasteners and insulation plates engage fasteners through insulation into deck to depth and in pattern required by Factory Mutual for FM Class specified in PART 2 and membrane manufacturer, whichever is more stringent.
F. Bead Applied Adhesive Attachment:
   1. Check to ensure the substrate is clean, free of debris and other contaminants and is fully dry. Adhesive cannot be applied to a wet or damp surface.
   2. Apply adhesive over the dry substrate area at the coverage rate and in pattern required by Factory Mutual for FM Class specified in PART 2 and membrane manufacturer, whichever is more stringent.
   3. Allow the adhesive to rise approximately 1/8 inch and develop stings prior to setting insulation boards into adhesive.
   4. Walk boards into adhesive and roll using a 30 inch wide, 100-150 pound weighted steel roller.
   5. Designate one person to walk/roll in all boards and trim/slit or apply weight as needed to ensure adequate securement.
G. Lay cover board over insulation and adhere with adhesive. Fit joints as specified for insulation.

3.05 SINGLE-PLY MEMBRANE INSTALLATION
A. Beginning at low point of roof, place membrane without stretching over substrate and allow to relax at least 30 minutes before attachment or splicing; in colder weather allow for longer relax time.
B. Lay out the membrane pieces so that field and flashing splices are installed to shed water.
C. Lay out the membrane so the seams do not run thru the drain sumps.
D. Install membrane without wrinkles and without gaps or fishmouths in seams; bond and test seams and laps in accordance with membrane manufacturer's instructions and details.
E. Install membrane adhered to the substrate, with edge securement as specified.
F. Adhered Membrane: Bond membrane sheet to substrate using membrane manufacturer's recommended bonding material, application rate, and procedures.
1. Do not apply bonding material to seaming area of membrane.
2. Seal seams with lap splice tape. Strip-in seam edges with batten cover tape.

G. Edge Securement: Secure membrane at all locations where membrane terminates or goes through an angle change greater than 2 in 12 inches using mechanically fastened reinforced perimeter fastening strips, plates, or metal edging as indicated or as recommended by roofing manufacturer.
   1. Exceptions: Round pipe penetrations less than 18 inches in diameter and square penetrations less than 4 inches square.
   2. Metal edging is not merely decorative; ensure anchorage of membrane as intended by roofing manufacturer.

3.06 FLASHING AND ACCESSORIES INSTALLATION

A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by membrane manufacturer's recommendations and details.

B. Metal Accessories: Install metal edgings, gravel stops, and wall caps in locations indicated on the drawings, with horizontal leg of edge member over membrane and flashing over metal onto membrane.
   1. Follow roofing manufacturer's instructions.
   2. Remove protective plastic surface film immediately before installation.
   3. Install water block sealant under the membrane anchorage leg.
   4. Flash with manufacturer's recommended flashing sheet unless otherwise indicated.
   5. If the roof edge includes a gravel stop, install an additional piece of self-adhesive flashing membrane over the metal lap to the top of the gravel stop; apply seam edge treatment at the intersections of the two flashing sections.
   6. When the roof slope is greater than 1:12, apply seam edge treatment along the back edge of the flashing.

C. Flashing at Walls, Curbs, and Other Vertical and Sloped Surfaces: Install weathertight flashing at all walls, curbs, parapets, curbs, hatches, and other vertical and sloped surfaces that the roofing membrane abuts to; extend flashing at least 8 inches high above membrane surface.
   1. Use the longest practical flashing pieces.
   2. Evaluate the substrate and overlay and adjust installation procedure in accordance with membrane manufacturer's recommendations.
   3. Complete the splice between flashing and the main roof sheet with specified Seam Tape before adhering flashing to the vertical surface.
   4. Provide termination directly to the vertical substrate as shown on roof drawings.
   5. Attach coping using a continuous galvanized metal cleat or hook strip on the exterior and hex head screws with sealing/bearing washers on the interior. Fasten the cleat 6 inches on center and space the exposed grommet fasteners 18 inches on center maximum.
   6. Install metal copings after composition flashing has been installed as shown in detailed drawings. The top surface of the copings shall slope to drain towards the inside of the roof and be fully supported below by a tapered wood nailer or tapered edge strip. Install joints with standing seam, style J8, in accordance with SMACNA Table 3-1.
   7. Coping terminations against walls or elevation changes shall receive a custom fabricated termination piece with wall flanges, set into butyl tape, fastened 8 inches on center maximum and sealed along the edge.

D. Roof Drains:
   1. Taper insulation around drain to provide smooth transition from roof surface to drain. Use specified pre-manufactured tapered insulation with facer or suitable bonding surface to achieve slope; slope not to exceed manufacturer's recommendations.
   2. Position membrane, then cut a hole for roof drain to allow 1/2 to 3/4 inch of membrane to extend inside clamping ring past drain bolts.
   3. Make round holes in membrane to align with clamping bolts; do not cut membrane back to bolt holes.
4. Apply sealant on top of drain bowl where clamping ring seats below the membrane, one tube per drain minimum.
5. Install roof drain clamping ring and clamping bolts; tighten clamping bolts to achieve constant compression.
6. Install raised ring on overflow drains and install grate dome. Verify raised overflow ring is on the proper drain assembly.

E. Flashing at Penetrations: Flash all penetrations passing through the membrane; make flashing seals directly to the penetration.
   1. Pipes, Round Supports, and Similar Items: Flash with specified pre-molded pipe flashings wherever practical; otherwise use specified self-curing elastomeric flashing.
   2. Pipe Clusters and Unusual Shaped Penetrations: Provide penetration pocket at least 2 inches deep, with at least 1 inch clearance from penetration, sloped to shed water.
   3. Structural Steel Tubing: If corner radii are greater than 1/4 inch and longest side of tube does not exceed 12 inches, flash as for pipes; otherwise, provide a standard curb with flashing.
   4. Flexible and Moving Penetrations: Provide weathertight gooseneck set in sealant and secured to deck, flashed as recommended by manufacturer.
   5. High Temperature Surfaces: Where the in-service temperature is, or is expected to be, in excess of 180 degrees F, protect the elastomeric components from direct contact with the hot surfaces using an intermediate insulated sleeve as flashing substrate as recommended by membrane manufacturer.

3.07 FIELD QUALITY CONTROL
   A. See Section 01 4000 - Quality Requirements, for additional requirements.
   B. Inspection by Manufacturer: Provide three inspections one at the start of the project, one in the middle and a final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes (i.e. not a sales person).
   C. Perform all corrections necessary for issuance of warranty.

3.08 CLEANING
   A. Clean all contaminants generated by roofing work from building and surrounding areas, including adhesives, sealants, and coatings.
   B. Repair or replace building components and finished surfaces damaged or defaced due to the work of this section; comply with recommendations of manufacturers of components and surfaces.
   C. Remove leftover materials, trash, debris, equipment from project site and surrounding areas.

3.09 PROTECTION
   A. Where construction traffic must continue over finished roof membrane, provide durable protection and replace or repair damaged roofing to original condition.

END OF SECTION
SECTION 07 5400 - THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Adhered system with thermoplastic roofing membrane.
B. Insulation, flat and tapered.
C. Deck sheathing.
D. Flashings.

1.02 RELATED REQUIREMENTS

A. Section 05 3100 - Steel Decking: Product requirements for acoustical insulation for deck flutes, for placement by this section.
B. Section 06 1000 - Rough Carpentry: Wood nailers and curbs.
C. Section 07 6200 - Sheet Metal Flashing and Trim: Counterflashings, reglets and drip edge.

1.03 REFERENCE STANDARDS


1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
C. Specimen Warranty: For approval.
D. Shop Drawings: Indicate joint or termination detail conditions.
E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
G. Installer's Qualification Statement.
H. Warranty Documentation:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's certification that installation complies with warranty conditions for waterproof membrane.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with 1.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.
   1. With minimum 3 years documented experience.
   2. Approved by membrane manufacturer.
   3. Work pertaining to the installation of Décor Systems shall only be done by Applicator personnel that have completed a mandatory one day installation and welding training course.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Deliver materials in manufacturer’s original containers, dry and undamaged, with seals and labels intact.
   B. Store materials in weather protected environment, clear of ground and moisture.
   C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
   D. Protect foam insulation from direct exposure to sunlight.

1.07 FIELD CONDITIONS
   A. Do not apply roofing membrane during unsuitable weather.
   B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 100 degrees F.
   C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
   D. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.08 WARRANTY
   A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
   B. Comply with all warranty procedures required by manufacturer, including notifications, scheduling, and inspections.
   C. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
      1. Warranty Term: 20 years.
      2. Limit of Liability: No dollar limitation.
      3. Warranty includes membrane roofing, base flashings, wall coping, roof insulation, fasteners, cover board, roofing accessories, walkway pads, and other components of membrane roofing system.
      4. Scope of Coverage: Repair leaks in roof system caused by:
         a. Ordinary wear and tear of the elements.
         b. Manufacturing defect materials.
         c. Defective workmanship used to install these materials.
         d. Damage due to winds up 90 mph.
         e. Hail up to 1.5 inches in diameter.
      5. Not Covered:
         a. Damage due to winds in excess of 90 mph.
         b. Damage due to hurricanes or tornadoes.
         c. Intentional damage.
         d. Unintentional damage due to normal rooftop inspections, maintenance, or service.
   D. Special Project Warranty:
      1. Submit roofing installer's warranty covering Work in this section, including all components of the membrane roofing system such as membrane roofing, base flashing, wall coping, roof insulation, fasteners, Coverboard, substrate boards, vapor barriers, and walkway pads for the following period:
      2. Two (2) Years from Substantial Completion.
PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermoplastic Polyvinyl Chloride (PVC) Membrane Roofing Materials:
   1. Sika Corporation Roofing; Decor Roof Systems: usa.sarnafil.sika.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation:
   1. As approved by membrane manufacturer.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROOFING - UNBALLASTED APPLICATIONS

A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation.

B. Roofing Assembly Requirements:
   1. Roof Covering External Fire Resistance Classification: UL (FRD) Class A.
   2. Factory Mutual Classification: Class 1 and windstorm resistance of 1-90, in accordance with FM DS 1-28.
   3. Insulation Thermal Value (R), minimum: 30; provide insulation of thickness required.

C. Acceptable Insulation Types - Constant Thickness Application: Any of the types specified.

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane: Sarnafil G410 thermoplastic membrane with fiberglass reinforcement, lacquer coating, and a factory applied 9oz felt backing
   1. PVC: Polyvinyl chloride (PVC) complying with ASTM D4434/D4434M, Type II, sheet contains reinforcing fibers or reinforcing fabrics.
      a. Thickness: 40 mil, 0.040 inch, minimum.
   2. Reinforcing: Both internal fabric and backing.
   3. Internal Reinforced Material: Fiberglass
   4. Thickness Over Scrim: .027 inch minimum
   5. Sheet Thickness: 0.060 inch, minimum.
   6. Sheet Width: Factory fabricated into largest sheets possible.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Flexible Flashing Material: Same material as membrane.

2.04 DÉCOR

A. Décor Profile
   1. Sarnafil PVC extrusion used to emulate the appearance of a standing seam metal rib roof system.
   2. Length: Ribs shall be 10 feet (3.04 M) long and weigh approximately 1.8 lbs (817 g)
   3. Dimensions: 1 inch (25.4) high with a base width of 1-3/8 inch (34.9 mm) and a profile width of 1/2 inch (12.7 mm). Ribs to be placed 18" O.C.

2.05 DECK SHEATHING AND COVER BOARDS

A. Deck Sheathing and Cover Board: Glass mat faced gypsum panels, ASTM C1177/C1177M, fire resistant type, 1/4 inch thick.
   1. Board Size: 48 by 48 inch
   2. Surface Water Absorption: 2.5 g maximum, when tested in accordance with ASTM C472.
   3. Surface Burning Characteristics: Flame spread index of zero, smoke developed index of zero when tested accordance with ASTM E84
   4. Combustibility: Noncombustible, when tested in accordance with ASTM E136
   5. Factory Mutual approved for use with rated roofing assemblies.
   7. Pre-primed for better adhesion.
8. Manufacturers:

2.06 INSULATION
   A. Polysiocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type II, Class 1, cellulose felt or glass fiber mat both faces; Grade 1 and with the following characteristics:
      1. Compressive Strength: 16 psi when tested in accordance with ASTM C1289
      2. Board Size: 48 by 48 inch.
      3. Ozone Depletion Potential: Zero; made without CFC or HCFC blowing agents
      4. Recycled Content; 19 percent post consumer and 15 percent pre-consumer (post-industrial), average.
      7. Manufacturer: As required by membrane manufacturer.
      8. Substitutions: See Section 01 6000 - Product Requirements.

2.07 ACCESSORIES
   A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
   B. Sarnaplate - Low Profile
      1. A specially-designed stress plate used with #12, HD (#14) and XP (#15) Sarnafasteners to attach insulation and/or roof boards directly to steel, wood, and concrete roof decks (not recommended for use directly over a plywood or OSB surface).
         a. Plate Dimension: 2-3/4 inch (70 mm) square.
         b. Thickness: 22 gauge
         c. Material: SAE 1010 steel with an AZ-50/55 Galvalume coating to meet Factory Mutual 4470 criteria for corrosion resistance.
   C. Insulation Fasteners: Sarnafastener #15 XP
      1. #15 corrosion-resistant fastener used with Sarnaplates to attach insulation and/or roof boards to steel roof decks.
         a. Shank Diameter: 0.21 inch (5.3mm)
         b. Thread Diameter: 0.26 inch (6.6mm)
         c. Head Diameter: 0.435 inch (11mm)
   D. Membrane Adhesive: Sarnacol 2170 VC.
   E. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
   F. Sealants: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL
   A. Perform work in accordance with 1 and manufacturer's instructions.
   B. Do not apply roofing membrane during unsuitable weather.
   C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
   D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
   E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.02 EXAMINATION
   A. Verify that surfaces and site conditions are ready to receive work.
   B. Verify deck is supported and secure.
C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
D. Verify deck surfaces are dry and free of snow or ice.
E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and nailing strips are in place.

3.03 METAL DECK PREPARATION
A. Install deck sheathing on metal deck:
   1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
   2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
   3. Mechanically fasten sheathing to roof deck, in accordance with Factory Mutual recommendations and roofing manufacturer’s instructions.

3.04 INSTALLATION - GENERAL
A. Perform work in accordance with manufacturer’s instructions, NRCA (RM), and NRCA (WM) applicable requirements.
B. Do not apply roofing membrane during unsuitable weather.
C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.05 INSULATION AND COVER BOARD INSTALLATION
A. Install insulation in configuration and with attachment method(s) specified in Part 2, under Roof System.
B. Install only as much insulation as can be covered the the completed roof system before the end of day work or before the onset of inclement weather.
C. Lay roof insulation in coursed parallel to roof edges.
D. Neatly and tightly fit insulation to all penetrations, projections, and nailers, with gaps not greater than 1/4 inch with acceptable insulation. Do not leave the roofing membrane unsupported over a space greater than 1/4 inch.
E. Mechanical Fastening: Using specified fasteners and insulation plates engage fasteners through insulation into deck to depth and pattern required by Factory Mutual for FM Class specified in PART 2 and membrane manufacturer, whichever is more stringent.
F. Lay cover board over insulation and mechanically fasten. Fit joints as specified for insulation.
G. Insure insulation and cover board is install in such a manner to provide a curve radius roof that is not segmented

3.06 MEMBRANE APPLICATION
A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
B. Over the properly installed and prepared substrate surface, adhesive shall be applied using solvent-resistant 3/4 inch (19 mm) nap paint rollers. The adhesive shall be applied to the substrate at a rate according to manufacturers requirements. No adhesive is applied to the back of the Sarnafil G410 feltback membrane. The adhesive shall be applied in smooth, even coats with no gaps, globs, puddles or similar inconsistencies. Only an area which can be completely covered in the same day’s operations shall be coated with adhesive. The first layer of adhesive shall be allowed to dry completely prior to installing a second layer of adhesive and the membrane.
C. The Sarnafil G410 feltback membrane is unrolled immediately into a second layer of wet adhesive. Adjacent to that first installed roll of membrane, another second layer of wet adhesive is applied and the second roll of membrane is immediately unrolled into it, overlapping the first roll by 3 inches (75 mm). This process is repeated throughout the roof area. Immediately after application into adhesive, the bonded sheet shall be pressed firmly in place with a minimum 100 lb (45 kg) steel, membrane roller, by rolling in two directions.

D. Do not allow the second application of adhesive to dry at all!

E. Weld Sarnafil G410 coverstrips at all Sarnafil G410 feltback seams that do not have a factory selvage edge.

F. At drip edges, extend membrane under gravel stop and to the outside face of the wall.

G. Around roof penetrations, seal flanges and flashings with flexible flashing.

3.07 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.

B. Require site attendance of roofing and insulation material manufacturers weekly during installation of the Work.

3.08 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.09 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION
SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fabricated sheet metal items, including flashings, counterflashings, and copings.
B. Reglets and accessories.

1.02 RELATED REQUIREMENTS
A. Section 05 7500 - Decorative Formed Metal: Metal fascia covers.
B. Section 06 1000 - Rough Carpentry: Wood nailers for sheet metal work.
C. Section 07 5323 - Ethylene-Propylene-Diene-Monomer Roofing (EPDM): Installation of wall copings.
D. Section 07 5419 Thermoplastic Single-Ply Roofing
E. Section 07 9200 - Joint Sealants: Sealing joints between sheet metal fabrications and sealing joints with adjacent construction.

1.03 REFERENCE STANDARDS
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.05 QUALITY ASSURANCE
A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
B. Wind Performance:
   1. At least the minimum required when tested in accordance with ANSI/SPRI ES-1 Test Method RE-3, current edition.
C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239 inch) thick base metal.

B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
   1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Architect from manufacturer's standard colors.

C. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20 gage (0.032 inch) thick; plain finish shop pre-coated with fluoropolymer coating.
   1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Architect from manufacturer's standard colors.

2.02 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer: Zinc chromate type.

C. Protective Backing Paint: Zinc molybdate alkyd.

D. Sealant: Per Section 07 9200 Joint Sealants.

E. Plastic Cement: ASTM D4586/D4586M, Type I.

F. Reglets: Surface mounted type, galvanized steel.

G. Anchor/Support Cleats: 22 gage, 0.0299 inch thick prepunched galvanized cleat with 12 inch wide stainless steel spring mechanically locked to cleat at 72 inches on center.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Fabricate cleats of same material as sheet, minimum two inches high, interlocking with sheet.

C. Form pieces in longest possible lengths.

D. Hem exposed edges on underside 3/4 inch; miter and seam corners.

E. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

G. Fabricate vertical faces with bottom edge formed outward 3/4 inch and hemmed to form drip.

H. Fabricate copings with an edge style E1 and corner style C1 in accordance with SMACNA. Terminations against walls or elevation changes shall receive a custom fabricated termination piece with wall flanges.

I. Fabricate sill flashings with ends and back edge turned upward to create water dam.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.
B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

A. Set surface reglets with fasteners appropriate for substrate. Seal top of reglet with sealant. Set counterflashings firmly in place after roof membrane installation.
B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.
C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
D. Seal metal joints watertight.
E. Install copings per Section 07 5323.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for field inspection requirements.
B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION
SECTION 07 7123 - MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pre-finished galvanized steel gutters and downspouts.
B. Precast concrete splash pads.

1.02 RELATED REQUIREMENTS

A. Section 07 6200 - Sheet Metal Flashing and Trim.

1.03 REFERENCE STANDARDS

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Conform to SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 10 years.
B. Conform to International Plumbing code for size and method of rain water discharge.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
C. Samples: Submit two samples, 12 inch long illustrating component design, finish, color, and configuration.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
B. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pre-Finished Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 22 gauge, 0.0299 inch thick base metal.
   1. Finish: Shop pre-coated with PVDF (polyvinylidene fluoride) coating.
   2. Color: As selected from manufacturer's standard colors.

2.02 COMPONENTS

A. Gutters: SMACNA Style F, box with angled front.
B. Downspouts: SMACNA Rectangular profile, 3 by 4 inches with open face.
C. Anchors and Supports: Profiled to suit gutters and downspouts.
   1. Anchoring Devices: In accordance with SMACNA requirements.
   2. Gutter Supports: Brackets.
   3. Downspout Supports: Brackets.
D. Fasteners: Same material and finish as gutters and downspouts, with soft neoprene washers.

2.03 ACCESSORIES

A. Splash Pads: Precast concrete type, size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.
1. Size: 12 inches wide by 24 inches long by 3 inches thick.
2. Profile: Turned up edges and back with 1 1/2 inch thick pan.

2.04 FABRICATION
A. Form gutters and downspouts of profiles and size indicated.
B. Fabricate with required connection pieces.
C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
D. Hem exposed edges of metal.

2.05 FINISHES
A. Fluoropolymer Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as selected from manufacturer's standard colors.
B. Primer Coat: Finish concealed side of metal sheets with primer compatible with finish system, as recommended by finish system manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify that surfaces are ready to receive work.

3.02 INSTALLATION
A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
B. Install full length seamless gutters. Seal gutter outlets and attach downspouts with screws.
C. Slope gutters 1/16 inch per foot.
D. Set splash pans under downspouts.

END OF SECTION
SECTION 07 9200 - JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Nonsag gunnable joint sealants.
   B. Self-leveling pourable joint sealants.

1.02 RELATED REQUIREMENTS
   A. Section 07 6200 - Sheet Metal Flashing and Trim: Sealing of lap joints.
   B. Section 08 7100 - Door Hardware: Setting exterior door thresholds in sealant.
   C. Section 08 8000 - Glazing: Glazing sealants and accessories.
   D. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
      1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
      2. List of backing materials approved for use with the specific product.
      3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
      4. Substrates the product should not be used on.
      5. Substrates for which use of primer is required.
   C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
   D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years experience.
   B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience.
   C. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS
   A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
   a. Wall expansion and control joints.
   b. Joints between door, window, and other frames and adjacent construction.
   c. Joints between different exposed materials.
   d. Flashing lap joints and roofing termination bars.
   e. Joints at walls and adjacent concrete slabs and sidewalks.

2. Interior Joints: Seal open joints, whether or not the joint is indicated on the drawings, unless specifically indicated not to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
   a. Joints between door, window, and other frames and adjacent construction.
   b. Joints between different finish materials.
   c. Joints between plumbing fixtures and finishes.
   d. Joints at countertops, backsplashes and abutting wall finishes.

3. Do not seal the following types of joints.
   a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
   b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
   c. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use nonsag two component polyurethane sealant, unless otherwise indicated.
   1. Lap Joints in Sheet Metal Fabrications: Non-staining silicone sealant.
   2. Control and Expansion Joints in Concrete Slabs: Self-leveling polyurethane "traffic-grade" sealant.
   3. Interior joints at floor finishes: Nonsag "traffic grade" polyurethane.

C. Interior Joints: Use nonsag acrylic latex sealant, unless otherwise indicated.
   2. Wall and Ceiling Joints in Wet Areas: Nonsag acrylic latex with silicone sealant, paintable.
   3. Floor Joints in Wet Areas: Self-leveling polyurethane "traffic-grade" sealant suitable for continuous liquid immersion.
   4. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
   5. Joints in FRP panels: Mildew-resistant silicone sealant; clear.
   6. In Sound-Rated Assemblies: See Section 09 2116 Gypsum Board Assemblies for required sealant.
   7. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant; Use at joints and cracks where floor will receive stained and sealed finish.
   8. Other Floor Joints: Nonsag polyurethane "traffic-grade" sealant.

D. Interior Wet Areas: restrooms and food service areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, and cabinets.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.02 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: __________, minimum.
   2. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   3. Hardness Range: 15 to 40, Shore A, when tested in accordance with ASTM C661.
   5. Cure Type: Single-component, neutral moisture curing.
   6. Service Temperature Range: Minus 65 to 180 degrees F.
7. Manufacturers:
   d. Substitutions: See Section 01 6000 - Product Requirements.

B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
   1. Manufacturers:
      e. Substitutions: See Section 01 6000 - Product Requirements.

C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
   2. Hardness Range: 30 to 40, Shore A, when tested in accordance with ASTM C661.
   4. Manufacturers:
      c. Sika Corporation; Sikaflex-1a: www.usa-sika.com/#sle.
      e. Substitutions: See Section 01 6000 - Product Requirements.

D. Polyurethane Sealant for Exterior Wall Opening Joints: ASTM C920, Grade NS, Uses M and A; multicomponent; explicitly approved by manufacturer for sealing joints between dissimilar materials.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Hardness Range: 25 to 40, Shore A, when tested in accordance with ASTM C661.
   3. Color: Match adjacent finished surfaces.
   4. Manufacturers:
      b. Sika Corporation; Sikaflex-2c NS: www.usa-sika.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

E. Non-Sag "Traffic-Grade" Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
   2. Hardness Range: 40 to 50, Shore A, when tested in accordance with ASTM C661.
   3. Color: Match adjacent finished surfaces.
   4. Service Temperature Range: Minus 40 to 170 degrees F.
   5. Manufacturers:
      d. Substitutions: See Section 01 6000 - Product Requirements.
F. General Purpose Interior Sealant: Acrylic latex with silicone; ASTM C834, Type OP, Grade NF single component, paintable.
   1. Color: Clear or match substrate color; if painted may use white.
   2. Manufacturers:
      d. Substitutions: See Section 01 6000 - Product Requirements.

G. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
   1. Color: white, paintable.
   2. Grade: ASTM C834; Grade - Minus 18 Degrees C.
   3. Manufacturers:
      c. Substitutions: See Section 01 6000 - Product Requirements.

H. Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag; not expected to withstand continuous water immersion or traffic.
   1. Hardness Range: 10 to 30, Shore A, when tested in accordance with ASTM C661.
   2. Color: black.
   3. Service Temperature Range: Minus 13 to 180 degrees F.
   4. Manufacturers:
      c. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SELF-LEVELING SEALANTS

A. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
   2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
   4. Service Temperature Range: Minus 40 to 180 degrees F.
   5. Manufacturers:
      d. Substitutions: See Section 01 6000 - Product Requirements.

B. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
   1. Composition: Multi-component, 100 percent solids by weight.
   2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
   3. Color: To be selected by Architect from manufacturer's standard colors.
   6. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth excluding space for backer rod.
7. Manufacturers:
   a. Dayton Superior Corporation; Pro-Poxy P606: www.daytonsuperior.com/#sle.
   d. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that joints are ready to receive work.
   B. Verify that backing materials are compatible with sealants.

3.02 PREPARATION
   A. Remove loose materials and foreign matter that could impair adhesion of sealant.
   B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
   C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
   D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
   E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION
   A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
   B. Perform installation in accordance with ASTM C1193.
   C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
   D. Install bond breaker backing tape where backer rod cannot be used.
   E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
   F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
   G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooing sealant surface.
   H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL
   A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
   B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.05 POST-OCCUPANCY
   A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION
SECTION 07 9513 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Expansion joint cover assemblies for floor, wall, ceiling, and roof surfaces.

1.02 RELATED REQUIREMENTS
   A. Section 04 2001 - Masonry Veneer: Placement of joint cover assembly frames in masonry.
   B. Section 07 9200 - Joint Sealants: Sealing expansion and control joints using gunnable and pourable sealants.
   C. Section 09 2116 - Gypsum Board Assemblies: Gypsum board control joint trim.
   D. Section 09 2116 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.

1.03 REFERENCE STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS
   A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.05 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
   C. Samples: Submit two samples 6 inch long, illustrating profile, dimension, color, and finish selected.
   D. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS
   A. Interior Wall/Ceiling Joints Subject to Thermal Movement:
      1. Manufacturers:
         d. Substitutions: See Section 01 6000 - Product Requirements.
   B. Exterior Wall Joints Subject to Thermal Movement:
      1. Manufacturers:
         d. Substitutions: See Section 01 6000 - Product Requirements.
2.03 EXPANSION JOINT COVER ASSEMBLIES
A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
   1. Joint Dimensions and Configurations: As indicated on drawings.
   2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
   3. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
   4. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
   5. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
B. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.

2.04 MATERIALS
A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T5 or T6 temper.
   1. Exposed Finish Outdoors: Natural anodized.
   2. Exposed Finish at Walls and Ceilings: Natural anodized.
B. Plate Aluminum: ASTM B209, 5052-H32.
C. Resilient Seals:
   1. For Walls: Santoprene, Shore A hardness of 60 to 70 Durometer.
   2. Color: Gray.
D. Moisture Barrier Bellow:
   1. For Walls: Polyurethane, PVC or EPDM.
   2. Color: Black.
E. Anchors and Fasteners: As recommended by cover manufacturer, countersunk flush heads.
F. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.
G. Threaded Fasteners: Stainless steel.
H. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

3.02 INSTALLATION
A. Install components and accessories in accordance with manufacturer's instructions.
B. Align work plumb and level.
C. Rigidly anchor to substrate to prevent misalignment.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Interior glazed borrowed lite frames.

1.02 RELATED REQUIREMENTS
A. Section 08 1416 - Flush Wood Doors: Non-hollow metal door for hollow metal frames.
B. Section 08 7100 - Door Hardware: Hardware.
C. Section 08 8000 - Glazing: Glazed borrowed lites.

1.03 REFERENCE STANDARDS
B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
G. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
J. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 DESIGN CRITERIA
A. Door Frame Type: Provide hollow metal door frames with integral casings.
B. Steel used for fabrication of frames shall conform to one or more of the following requirements; galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
C. Accessibility: Conform to ICC A117.1 and ADA Standards.
D. Combined Requirements: If a particular door and frame unit is indicated to conform to more than one type of requirement, conform to the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must conform to the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, conform to the most stringent.

E. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

F. Frames for Interior Glazing or Borrowed Lites: Construction and face dimensions to match door frames, and as indicated on drawings.

2.03 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer’s standard.

2.04 ACCESSORIES

A. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.

B. Removable Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.

C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer’s standard.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install frames in accordance with manufacturer’s instructions and related requirements of specified frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Conform to glazing installation requirements of Section 08 8000.

D. Install door hardware as specified in Section 08 7100.

END OF SECTION
SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Flush wood doors; flush and flush glazed configuration; non-rated.

1.02 RELATED REQUIREMENTS
   A. Section 08 1213 - Hollow Metal Frames.
   B. Section 08 7100 - Door Hardware.
   C. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS
   A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
   B. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2013.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
   C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
   D. Specimen warranty.

1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum seven years of experience.
   B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Package, deliver and store doors in accordance with specified quality standard.
   B. Accept doors on site in manufacturer's packaging. Inspect for damage.
   C. Top and bottom rails shall be factory sealed.
   D. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Break seal on site to permit ventilation.

1.07 WARRANTY
   A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
   B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
   C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Wood Veneer Faced Doors:
      6. Substitutions: See Section 01 6000 - Product Requirements.
2.02 DOORS
A. Doors: See drawings for locations and additional requirements.
   1. Quality Level: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 1A.
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Wood veneer facing with factory transparent finish.

2.03 DOOR AND PANEL CORES
A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS
A. Veneer Facing for Transparent Finish: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Same species as face veneer.
   2. "Running Match" each pair of doors and doors in close proximity to each other.
B. Facing Adhesive: Type I - waterproof.

2.05 DOOR CONSTRUCTION
A. Fabricate doors in accordance with door quality standard specified.
B. Cores Constructed with stiles and rails:
   1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

2.06 FACTORY FINISHING - WOOD VENEER DOORS
A. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
   1. Transparent:
      b. Stain: Match existing doors.
      c. Sheen: Semigloss.
B. Factory finish doors in accordance with approved sample.

2.07 ACCESSORIES
A. Hollow Metal Door Frames: As specified in Section 08 1213.
B. Glazing: As specified in Section 08 8000.
C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
D. Door Hardware: As specified in Section 08 7100.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify that opening sizes and tolerances are acceptable.
C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION
A. Install doors in accordance with manufacturer's instructions and specified quality standard.
B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
C. Use machine tools to cut or drill for hardware.
D. Coordinate installation of doors with installation of frames and hardware.
E. Coordinate installation of glazing.

3.03 TOLERANCES
A. Conform to specified quality standard for fit and clearance tolerances.
B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING
A. Adjust doors for smooth and balanced door movement.
B. Adjust closers for full closure with appropriate backcheck to keep doors from slamming.

END OF SECTION
SECTION 08 3100 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Wall access door and frame units.

1.02 RELATED REQUIREMENTS
   A. Section 09 9123 - Interior Painting: Field paint finish.

1.03 REFERENCE STANDARDS
   A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES
   A. Wall-Mounted Units:
      1. Material: Steel, hot-dipped zinc or zinc-aluminum-alloy coated.
      2. Size: 12 inch by 12 inch.
      3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
      4. In Gypsum Board: Drywall bead frame with door surface recessed for infill with wall finish.

2.02 WALL AND CEILING MOUNTED UNITS
   A. Manufacturers:
      4. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION
   A. Install units in accordance with manufacturer's instructions.
   B. Install frames plumb and level in openings, and secure units rigidly in place.
   C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION
SECTION 08 4313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.
B. Infill panels of metal.
C. Aluminum doors.
D. Weatherstripping.

1.02 RELATED REQUIREMENTS

A. Section 07 2119 - Foam-in-Place Insulation: Insulation between storefront frames and wall systems.
B. Section 07 2500 - Weather Barriers: Sealing framing to weather barrier installed on adjacent construction.
C. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.
D. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.
E. Section 08 8000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details and flashing.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
1.06 QUALITY ASSURANCE
   A. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum seven years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING
   A. Handle products of this section in accordance with AAMA CW-10.
   B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS
   A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY
   A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
   B. Correct defective Work within a two year period after the Date of Substantial Completion.
   C. Provide two year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
   D. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.
   E. Provide Limited Lifetime manufacturer warranty against failure of corner construction joinery and defects in workmanship and material for entrance doors.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Aluminum-Framed Storefront and Doors:
      4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STOREFRONT
   A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
      1. Glazing Rabbet: For 1 inch insulating glazing.
      4. Finish: Class I natural anodized.
         a. Factory finish all surfaces that will be exposed in completed assemblies.
      5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
      7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
      8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without...
causing detrimental effect to system components, anchorages, and other building elements.

9. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.

10. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

11. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and heel bead of glazing compound.

B. Performance Requirements:

1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Basic Wind Speed: 90 mph
   b. Risk Category: III
   c. Exposure Category: C
   d. Member Deflection: Limit member deflection to 1/175 in any direction, with full recovery of glazing materials.

2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.

3. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.24 psf pressure differential across assembly.

4. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

5. Overall U-value Including Glazing: 0.40 Btu/(hr sq ft deg F), maximum.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections with thermally broken frames at exterior locations and non-thermally broken frames at interior locations, drainage holes and internal weep drainage system.
   2. Deflection Channel: Isolate forces imposed by roof live loads; extruded aluminum with thermally broken frame and gaskets.

B. Glazing: As specified in Section 08 8000.

C. Infill Panels: Insulated, aluminum sheet face and back, with rabbet panel edges formed to fit glazing channel and sealed.
   1. Exterior Face Sheet: 0.032 inch thick.
   2. Substrate: 1/8 inch thick tempered hardboard.
   3. Exterior Core: Rigid expanded polystyrene insulation core, 11/16 inch thick, with R-value of 3.0.
   5. Intermediate Face Sheet: 0.032 inch thick.
   6. Insulation Core: Rigid expanded polystyrene insulation core, 1 19/32 inches thick, with R-Value of 7.9.
   8. Interior Face Sheet: 0.032 inch thick.
   10. Manufacturers:
       b. Window Manufacturer's standard product that meets specified characteristics.
       c. Substitutions: See Section 01 6000 - Product Requirements.

D. Swing Doors: Glazed aluminum.
1. Thickness: 2 inches, 3/16 inch wall thickness.
2. Rail and Stile Widths: As shown on Drawings.
3. Finish: Same as storefront.

2.04 MATERIALS
A. Extruded Aluminum: ASTM B221 (ASTM B221M) 6063-T6 alloy and temper.
C. Fasteners: Stainless steel.
D. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.
E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
F. Glazing Accessories: As specified in Section 08 8000.

2.05 FINISHES
A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.06 HARDWARE
A. Weatherstripping: Wool pile or thermoplastic elastomeric fin, continuous and replaceable; provide on all doors.
B. Sill Sweep Strips: Resilient seal type, of flexible blade fin of rubber or EPDM; provide on all doors.
C. See Section 08 7100 Door Hardware for additional requirements.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify dimensions, tolerances, and method of attachment with other work.
B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION
A. Install wall system in accordance with manufacturer's instructions.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Make attachments with components allowing movement of building structure without imposing loads on storefront system.
E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
H. Coordinate installation of spray foam insulation to seal space between rough opening framing elements and storefront frame.
I. Set thresholds in bed of sealant and secure.
J. Install hardware using templates provided.
   1. See Section 08 7100 for hardware installation requirements.
K. Install glass in accordance with Section 08 8000, using exterior dry glazing method.
L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES
   A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
   B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 ADJUSTING
   A. Adjust operating hardware for smooth operation.

3.05 CLEANING
   A. Remove protective material from pre-finished aluminum surfaces.
   B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

3.06 PROTECTION
   A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION
PART 1 GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplemental
      Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section Includes:
      1. Provision of door hardware for swinging doors and other doors to the extent indicated.
      2. Cylinders and keying for doors to the extent indicated.
      3. Exclusions: Unless specifically listed in hardware sets, hardware not specified in this
         section for:
         a. Hardware for casework, cabinets, or windows.
      4. Related Sections
         a. Section 08 1213 - Hollow Metal Frames.
         b. Section 08 1416 - Flush Wood Doors.
         c. Section 08 4313 - Aluminum-Framed Storefronts.

1.03 REFERENCED STANDARDS
   A. American National Standards Institute (ANSI):
      1. International Code Council (ICC), ANSI/ICC A117.1 - Accessible and Usable Buildings and
         Facilities, edition as adopted by local Authority Having Jurisdiction (AHJ).
      2. Builders Hardware Manufacturer’s Association (BHMA):
         c. ANSI/BHMA A156.3 - Exit Devices; 2014 edition.
         d. ANSI/BHMA A156.4 - Door Controls - Closers; 2013 edition.
         e. ANSI/BHMA A156.6 - Architectural Door Trim; 2010 edition.
         f. ANSI/BHMA A156.8 - Door Controls - Overhead Stops and Holders; 2010 edition.
         h. ANSI/BHMA A156.18 - Materials and Finishes; 2012 edition.
         i. ANSI/BHMA A156.21 - Thresholds; 2014 edition.
         j. ANSI/BHMA A156.22 - Door Gasketing and Edge Seal Systems; 2012 edition.
         l. ANSI/BHMA A156.36 - Auxiliary Locks; 2010 edition.
   3. Door and Hardware Institute (DHI):

1.04 SUBMITTALS
   A. General:
      1. Provide submittals in accordance with Section 01 3300 - Administrative Requirements:
         Submittal Procedures.
      2. Highlight, circle, or otherwise specifically identify deviations from Contract Documents,
         issues of incompatibility, or other issues which may detrimentally affect the work.
      3. Product Data: Submit manufacturer’s technical product data for each item of door
         hardware. Highlight relevant product information such as model, function, trim, finish,
         options, electrical requirements, and accessories.
      4. Hardware Schedule: Submit hardware schedule detailing fabrication and assembly of door
         hardware as well as procedures and diagrams. Coordinate the final door hardware sets
         with doors, frames, and related work to ensure proper size, thickness, hand, function, and
         finish of door hardware.
         a. Format schedule complying with the vertical format in DHI’s "Sequence and Format
            for the Hardware Schedule" publication.
1) Use same door numbers as found in contract documents and group doors with like hardware under a single heading.

2) Identify each heading with the submitted heading number and Architect’s specified hardware set number.

3) Each heading shall include a list of applicable openings with information as follows: Architect’s specified door number, to/from location, maximum door swing, handing information, door and frame sizes and materials, applicable ratings, and other information that may impact the door hardware.

4) Each heading shall also include complete designations of every hardware item including: quantity per opening, manufacturer, description of item, and complete model number designating type, style, function, size, finish, fasteners, and other options required for the provision of hardware. Indicate non-standard installation requirements or mounting heights, and list related door devices specified in other sections.

5. Keying Schedule: After final approval of hardware scheduled, submit keying schedule detailing Owner’s final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations complying with DHI’s “Keying Systems and Nomenclature” publication.
   a. Include schematic keying diagram and index each key to unique door designations.
   b. Index keying schedule by door number, keyset, hardware heading number. Include cross-keying instructions and special key stamping instructions.
   c. Provide one complete bitting list of key cuts and key system schematic illustrating system usage and expansion.

6. Manufacturer’s Templates: After final approval of the hardware schedule, provide templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware.

7. Operations and Maintenance Data: Provide in accordance with Section 01 7800 - Closeout Submittals.
   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Name, address, and phone number of local representative for each manufacturer.
   d. Parts list for each product.
   e. Final approved hardware schedule edited to reflect conditions as-installed.
   f. Final key schedule including bitting lists and schematic diagram.
   g. Copies of floor plans with keying nomenclature.
   h. Copy of manufacturer special warranty certificates stating period and conditions. Accompany with copies of each order confirmation or original packing slip containing manufacturer’s original order number, date of manufacture, and shipment date.
   i. Special Warranty Certificates including:
      1) Warranty certificates from manufacturer stating warranty period and conditions, complying with warranty requirements specified herein.
      2) Copy of manufacturer’s order confirmation or original packing slip with manufacturer’s original order #, date of manufacture, and ship date.

1.05 QUALITY ASSURANCE

A. Product Substitutions: Comply with product requirements stated in Section 01 6000 - Product Requirements.
   1. Manufacturers and products indicated as approved for provision are subject to compliance with specified requirements and “Single Source Responsibility” requirements stated herein.
   2. Where specific manufacturer’s product(s) are named and accompanied by “No Substitute”, including make or model number or other designation, provide product specified (Note: certain products have been selected for their unique characteristics and particular project suitability).
      a. Where no additional products or manufacturer’s are listed in product category, requirements for “No Substitute” govern product selection.
3. **Supplier Qualifications:** Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project.
   a. Supplier shall submit documentation certifying compliance with the following requirements.
      1) Supplier shall have warehousing facilities within project’s vicinity.
      2) Supplier shall be a factory-direct authorized dealer for the hardware being furnished and is able to provide ongoing sales, service, and technical support for furnished products.
   b. Supplier is to make available an architectural hardware consultant meeting requirements herein during work for consultation with Owner, Architect, and Contractor.
      1) Supplier’s Architectural Hardware Consultant shall be responsible for coordinating door/frame templating for hardware installations.
      2) Supplier’s Architectural Hardware Consultant shall be responsible for final inspection and approval of installation for mechanical hardware supplied under this section. Warranty issues or product defects due to improper installations that are not corrected as part of final inspection and installation approval process shall be covered under supplier’s warranty service.

4. **Installer Qualifications:** Installer shall be qualified tradesman with documented minimum experience of 3 years in the installation of door hardware similar in quantity, type, and quality to that indicated for this project. Installer shall hold any licenses required by authority having jurisdiction or any certifications recommended by hardware manufacturer(s) prior to installing hardware.
   a. Installer shall submit documentation certifying past experience and holding of appropriate licenses and certifications.

5. **Architectural Hardware Consultant Qualifications:** Architectural Hardware Consultant shall be experienced in providing consulting services for door hardware installations comparable in material, design, and extent to that indicated for this Project.

6. **Single Source Responsibility:** Obtain each type of door hardware from a single manufacturer, even though several may be indicated as acceptable for inclusion into the work.
   a. Provide hardware as ordered directly from original manufacturer, hardware components that are modified outside of original manufacturer’s assembly process, except where specifically indicated within this section, are not acceptable.

7. **Means of Egress Doors:** Except where specifically allowed by applicable building codes and the authorities having jurisdiction, latches shall not require more than 15 lbf to release latch, locks shall not require use of key, tool, or special knowledge to allow egress. Doors shall unlatch/unlock to allow egress in a single motion.

8. **Accessible Doors:** Provide hardware for accessible openings that complies with ANSI/ICC A117.1 requirements in addition to the accessibility requirements of the applicable building codes and as required by authorities having jurisdiction. Except as otherwise allowed by these standards, provide hardware that meets the following:
   a. Operating devices shall not require tight grasping, pinching, or turning of wrist.
   b. Maximum Opening Force requirements:
      1) Interior, Non-Fire Rated Swing Doors: 5 lbs applied perpendicular to door at latch.
   c. Thresholds & Sills: Provide thresholds and sills with rises exceeding 1/4 inch to have beveled slopes of not more than 1:2. Thresholds shall not exceed 1/2 inch in height.

9. **Keying Conference:** Prior to ordering hardware, conduct conference at project site to coordinate.
   a. Required Attendees: Owner’s Security Representative, Architect, Contractor, and Door Hardware Supplier’s Architectural Hardware Consultant.
   b. Incorporate decisions made into final keying schedule after reviewing door hardware keying system including:
1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2) Preliminary key system schematic design diagram and layout.
3) Quantities required for cut keys, extra cylinders/cores, pinning kits and tools, and key cutting tools.
4) Requirements for key control system.
5) Delivery requirements of permanent cylinders/cores, keys, and bitting lists.

10. Pre-Installation Conference: Conduct conference at project site to comply with requirements of Section 01 3000 - Administrative Requirements.
   a. Required Attendees: Architect, Owner’s Security Consultant, Contractor, Supplier’s Architectural Hardware Consultant, and Door Hardware Installer.
   b. After meeting, provide letter of compliance to Architect indicating when meeting was held, who was in attendance, and that the following items were discussed.
      1) Review and finalize construction schedule and verify availability of materials, installer’s personnel, equipment, and facilities needs to avoid delays.
      2) Inspect and discuss preparatory work performed by other trades.
      3) Review required testing, inspecting, and certifying procedures.
      4) Review questions or concerns about proper installation and adjustment of door hardware.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Marking and Packaging: Package hardware items manufacturer’s standard packaging. Tag each item or package separately with identification coordinated with final door hardware schedule. Include installation instructions, templates, and necessary fasteners with each item or package.

B. Delivery and Acceptance: Except where specifically approved by Contractor, direct shipments from factory to place of installation are not permitted. Coordinate with construction schedule and deliver packaged hardware items to place of installation (e.g. project site, fabrication shop). Upon delivery, inspect and inventory door hardware. Any hardware items damaged or missing during shipment shall be replaced promptly.
   1. Deliver/ship permanent cylinders/cores, keys, and key control system as directed by Owner’s Security Consultant during keying meeting.
   2. Storage: Maintain manufacturer-recommended environmental conditions throughout storage and installation periods. Provide secure lock-up area for door hardware delivered to the project site, but not yet installed. Store items on shelves or pallets to prevent damage.
   3. Handling: Control handling and installation of hardware items that are not immediately replaceable so that completion of work will not be delayed by hardware losses both before and after installation.
      a. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace, or repair products damaged during Work.
      b. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

1.07 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.08 WARRANTY

A. General Warranty: Warrant door hardware against defects in material and workmanship as set forth in Section 01 7800: “Closeout Submittals”.
B. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
      a. Continuous Hinges: Lifetime of Building.
      b. Locks & Latches:
         1) Mechanical Grade 1 Cylindrical: 10 Years.
         2) Exit Devices:
            (a) Mechanical: 5 Years.
         3) Closers:
            (a) Mechanical, Heavy Duty: 30 Years.

1.09 MAINTENANCE
A. Maintenance Material Submittals: Furnish a complete set of specialized tools and maintenance instructions needed for owner’s continued adjustment, maintenance, removal, and replacement of door hardware.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Approval of products from manufacturers indicated as acceptable in the individual article for the product category is contingent upon those products providing all functions, features, and meeting all requirements of the scheduled manufacturer’s product.
B. Approval of manufacturers and/or products other than those listed as acceptable in the individual article for the product category shall be in accordance with the QUALITY ASSURANCE article, herein.
C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect’s approval.

2.02 MATERIALS
A. Fasteners: Provide fasteners for each hardware item and application as recommended by the hardware manufacturer. Finish of fasteners shall match adjacent hardware and shall be concealed wherever possible. Where sets indicate hardware is to be supplied with security screws, provide manufacturer’s recommended fastener with a torx-drive head.
B. Miscellaneous Hardware Items: Where hardware items are scheduled, but are not included in the requirements of the specification, provide item as scheduled or a product similar in appearance, quality, performance, and function. Where possible, provide product to comply with the requirements of the applicable ANSI/BHMA A156 standard.
C. Door Operation: Drawings show direction of slide or swing and hand of each door leaf. Furnish each hardware item for proper installation and operation of door movement as shown to maximum degree of opening as allowed by adjacent wall conditions, columns, casework, or other permanent fixtures. Where scheduled hardware does not allow maximum degree of swing and alternative solution exists, provide alternative hardware that allows maximum degree of swing, subject to Architect’s approval.

2.03 HINGES
A. General: Provide a minimum of 2 hinges per door leaf. For door leaves exceeding 60 inches in height, provide a minimum of 1 hinge for every 30 inches or portion thereof.
B. Architectural Hinges: Provide hinges for exterior doors to be constructed of either stainless steel or brass with stainless steel pins. Hinges for interior doors shall be constructed of either steel or stainless steel. Provide hinge with grade, number of knuckles, and type (e.g. full mortise) as scheduled. Provide hinges with non-rising pins with flat button tips. Where scheduled on reverse handed doors also scheduled with locking hardware, provide hinges with non-removable pins (NRP). Provide minimal hinge width required to allow hinge barrel to clear jamb and trim and
allow door to swing 180 degrees. Provide minimum hinge height and ANSI/BHMA A156.1 grade as follows:

1. Doors 1-3/4 inches thick, up to 36 inches wide: 4-1/2 inch hinge, Grade 2
2. Doors 1-3/4 inches thick, 36 to 48 inches wide: 5 inch hinge, Grade 1
3. Doors 2 inches thick, up to 42 inches wide: 5 inch hinge, Grade 1
4. Doors 2 inches thick, 42 to 48 inches wide: 6 inch hinge, Grade 1
5. Acceptable Products:
   a. Grade 1: Ives 5BB1HW, McKinney TB3786, Hager BB1168, No Substitution.
   b. Grade 2: Ives 5BB1, McKinney TB2714, Hager BB1279, No Substitution.

2.04 CONTINUOUS HINGES

A. General: Continuous hinges shall be provided with length equal to door height less 1 inch.
B. Aluminum Geared Continuous Hinges: Provide full surface continuous hinge constructed of extruded aluminum consisting of two individual geared leafs held together with a full length cover channel. Hinge shall have a series of anti-friction bearings installed in a center-focused design. Hinge shall have lateral and vertical adjustability while the door is still hanging.
C. Acceptable Products:
   1. Ives 157XY, No Substitution.

2.05 SECURING DEVICES FOR PAIRS OF DOORS

A. Flush Bolts: Provide flush-mounted door bolts of the type scheduled. Provide model recommended by hardware manufacturer for the door material for each opening. Where possible, provide length as required for top bolt to mount no higher than 72 inches above finished floor to center of bolt release mechanism and bottom bolt to mount no lower than 12 inches above finished floor to center of bolt release mechanism. Where opening is scheduled to receive a bottom bolt, provide a dust proof strike.
B. Acceptable Products:

2.06 MECHANICAL LOCKS AND LATCHES

A. Cylindrical Locks: Provide cylindrical lock meeting ANSI A156.2 Series 4000, Grade 1. Lock shall have chassis constructed of chrome or zinc-dichromate plated steel. Provide lock with minimum of 1/2 inch stainless steel latchbolt. Latchbolt shall deadlatch at locking functions. Provide lockset with cylinder preps as necessary for compatibility with the specified cylinders/cores. Lock shall utilize two (2) compression springs for each lever, locks utilizing torsion or tension type springs are not acceptable. Lever return springs shall be accessible without dismantling lock chassis. Lock shall be convertible to all other standard lock functions without replacing the lock chassis. Provide locksets with clutching lever that freely rotates when locked.
B. Trim: Provide trim with levers constructed of pressure cast or forged brass, bronze, zinc, or stainless steel. Levers shall be solid, not having any voids or fillers. Provide cast or wrought rose escutcheons and levers with design as scheduled.
C. Strikes: Provide locks with standard 4-7/8 inch ANSI strike plate. On single openings, strike shall have curved lip with dimension necessary to extend 1/8 inch beyond trim. On paired openings, strike shall have flat lip with dimension necessary to extend flush to face of door leaf.
D. Acceptable Products:

2.07 PANIC HARDWARE AND ACCESSORIES

A. Panic Hardware: Provide conventional push pad type exit device complying with ANSI A156.3 Grade 1. Device shall be constructed of a stamped steel base plate inside of an extruded aluminum mechanism case. Push pad shall be constructed of aluminum extrusion with stainless steel cover. Mechanism case and push pad shall conceal rivets and fasteners. End cap shall be constructed of cast steel and designed for flush transition from mechanism case. Device shall
utilize compression springs for push pad actuation, latchbolt return, and lever return springs. Device shall have deadlocking pullman type latchbolt constructed of stainless steel.

B. Removable Mullions: Provide panic hardware manufacturer's standard steel mullion. Where scheduled, mullion shall be removable by key otherwise provide mullion to be removable by hex key. Provide mullions at exterior openings with stabilizer fins.

C. Acceptable Products:

2.08 CYLINDERS, KEY SYSTEMS, AND KEY CONTROL

A. Key System: Provide new cylinders to integrate into existing key system. Owner will provide bitting lists as required.

B. Cylinders and Keys: Cylinders shall be compatible with manufacturer’s standard interchangeable core. Provide cylinders with type (e.g. mortise, rim, etc), length, and cam/tailpiece as required for compatibility with adjacent locking hardware.
   1. Provide each cylinder with keyed alike temporary cores for the duration of the construction period. Cut temporary keys shall be provided in sufficient quantity as required by construction needs. Temporary cores shall remain property of the contractor/supplier and shall be returned upon installation of permanent cores at substantial completion.
   2. Provide factory pinned permanent cores that bear concealed markings indicating applicable key symbol. Upon substantial completion, owner will accompany contractor during installation of permanent cores.
   3. Permanent Keys: Provide manufacturer’s standard brass or nickel silver keys with a minimum quantity of 2 keys for each permanent core provided. Finalize quantity of keys to be cut to each key symbol during keying meeting – remaining keys shall be left blank for owner’s future key cutting needs. Engrave each cut key with keyway and key symbol marking and engrave cut master keys with key system registry number.
   4. Bitting Lists: Provide one copy of the key system bitting list directly from key system manufacturer.
   5. Acceptable Products:
      a. Key System: Schlage, Full Size Interchangeable Core, Match Existing Keyway.

2.09 OPERATING DOOR TRIM

A. Push And Pull Plates: Provide plates constructed of .050 inch thick stainless steel or brass material. Plates shall have four beveled edges and countersunk screws. Provide places of size as scheduled. Where required, provide plates to be cut for cylinder. Provide 1 inch pulls with center to center length of 10 inches. Pulls shall be mounted to pull plate using concealed fasteners.

B. Acceptable Products:
   1. Push Plates: Ives 8200, Rockwood 70, Trimco 1001, or approved equivalent.
   2. Pull Plates: Ives 8303, Rockwood 111 x 70, Trimco 1018, or approved equivalent.

2.10 MECHANICAL DOOR CLOSERS

A. Provide closers certified to ANSI A156.4 grade 1, with handed body constructed of cast iron. Closers shall have 1-1/2 inch piston, 3/4 inch journals, double heat treated pinions, and springs sized 1-6. Closers shall have independent valves for backcheck, main speed, and latch speed. Pressure Relief Valves (PRVs) are prohibited. Closer shall be able to meet ADA opening force requirements. Provide arms as scheduled, where multiple configurations are scheduled provide the closer/arm configuration for mounting on the least public side of door. Provide closers with universal screw packs complete with through-bolts, wood screws, and template machine screws.

B. Acceptable Products:
   1. LCN 4040XP Series, No Substitution.
2.11 DOOR PROTECTION

A. Protection Plates: Provide protection plates constructed of .050 inch thick brass or stainless steel. Provide plates with 4 beveled edges and countersunk screws. At stile and rail or full-lite doors, provide plates with height 1 inch less bottom rail height. Otherwise, provide plates with heights as scheduled in the hardware sets. Provide widths equal to either 1 inch less door width (LDW) or 2 inch LDW as scheduled in the hardware sets. Where plates are provided with height greater than 16 inches on fire rated doors, provide UL listed plate with a permanent and visible marking indicating said listing.

B. Acceptable Products:
1. Ives 8400 Series or approved equivalent.

2.12 DOOR STOPS

A. General: Provide stops as scheduled in the hardware sets. Where more than one door stop is scheduled, provide one door stop per door leaf according to the following requirements.
1. Wall Stops: Provide indicated wall stop at locations where door edge swings against a masonry or gypsum board wall that has the proper blocking installed.
2. Floor Stops: Provide indicated floor stop only in areas where wall stop is not appropriate, where floor surface is carpet, wood, or laminate, and where stop may be mounted near a wall, structural member, casework, furniture/equipment, etc. such that a tripping hazard is not created to cross-directional traffic.
3. Overhead Stops: Provide indicated overhead stop where wall and/or floor stop are not appropriate. Where overhead stops are required on interior doors with parallel arm closers, overhead stop may be omitted in lieu of a spring stop type closer arm.
4. Where none of the indicated stops are appropriate for use, notify architect immediately with recommendations to stop the door in an appropriate manner for the condition.
5. Interior Wall Stops & Holders: Provide interior wall stops to meet ANSI/BHMA 156.16 Type L22251. Provide interior wall holders to meet ANSI/BHMA 156.16 Type L11291.
6. Exterior Floor Stops: Provide exterior floor stops constructed of threaded rod encased in black rubber to be grouted into flooring.
7. Interior Floor Stops: Provide interior floor stops constructed of cast zinc or stainless steel with base height of 1/4 inch and a pad height of 1-1/8 inch for universal application.
8. Surface Overhead Stops & Holders: Provide heavy duty surface mounted overhead stops and holders to meet ANSI/BHMA 156.4 Type C025*1 (asterisk indicates number that changes based on scheduled option). Provide standard duty surface mounted overhead stops and holders to meet ANSI/BHMA 156.4 Type C055*1 (asterisk indicates number that changes based on scheduled option).
9. Concealed Overhead Stops & Holders: Provide concealed overhead stops and holders to meet ANSI/BHMA 156.4 Type C015*1 (asterisk indicates number that changes based on scheduled option). Provide stop with adjustable arm bracket.
10. Acceptable Products:
   b. Interior Wall Holder: Ives WS45 or any BHMA equivalent product.
   c. Exterior Floor Stop: Ives FS18S or any BHMA equivalent product.
   d. Interior Floor Stop: Ives FS439 or any BHMA equivalent product.
   e. Heavy Duty Surface Overhead Stop/Holder: Glynn Johnson 90 Series or any BHMA equivalent product.

2.13 THRESHOLDS & SADDLES

A. General: Provide saddle with continuous length equal to opening width from frame rabbet to frame rabbet. Notch threshold as required to fit frame profile, miter and weld any exposed corners. Where scheduled, provide threshold with composite filled body and/or slip resistant options.

B. Exterior Saddle Thresholds: Provide saddle threshold 1/2 inch in height with profile to meet accessibility requirements. Provide saddle with width as scheduled. Provide threshold with stainless steel machine screws and lead expansion anchors.
C. Acceptable Products:
   1. Saddle Thresholds: National Guard Products 425HD or any BHMA equivalent product.

2.14 WEATHER STRIP & GASKET
   B. Interior Perimeter Gasketing: Provide interior doors with perimeter gasketing made of sponge-neoprene in the shape as scheduled. Provide continuous length roll of gasketing equal to frame perimeter. Attach gasketing using 3M adhesive backing. Where an opening is scheduled to receive 2 sets of gasketing, apply one set to the frame rabbet and one set to the frame stop in the configuration recommended by the gasket manufacturer.
   C. Meeting Stile Gasketing: Provide meeting stiles as scheduled with a length equal to door leaf height less undercut dimension. For surface-mounted meeting stiles, provide one meeting stile for each door leaf and mount on secure face of door.
   D. Overlapping Astragals: Provide overlapping astragals as scheduled for mounting on the secure side of the opening. If opening is reverse handed, astragal shall be provided to mount on pull side of active leaf. If opening is regular handed, astragal shall be provided to mount on push side of inactive leaf. Provide astragal with length equal to door height less 1 inch. Secure astragal to door using through-bolts.
   E. Door Bottom and Door Sweeps: See Section 08 4313 - Aluminum Framed Storefronts.
   F. Acceptable Products:
      1. Scheduled products by National Guard Products or any BHMA equivalent products.

2.15 MISCELLANEOUS MECHANICAL HARDWARE
   A. Silencers: Provide 3 silencers where indicated for single leaf door openings and 2 silencers where indicated for paired leaf door openings. Provide silencers with the mounting type (press-in, nail-in, or self adhesive) required by the frame manufacturer. Coordinate with Section 08 1213 - Hollow Metal Frames.
   B. Acceptable Products
      1. Ives SR60 Series or any BHMA equivalent product.

2.16 FINISHES
   A. Provide finishes to match the scheduled ANSI/BHMA A156.18 finish code indicated for each hardware item.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify conditions of walls, flooring, doors, frames, and hardware are satisfactory for installation of hardware. Conditions that do not allow proper installation of hardware shall be corrected before proceeding.

3.02 INSTALLATION
   A. General
      1. Install door hardware as detailed in the approved hardware schedule using only approved fasteners and in accordance with manufacturer’s recommended procedures and methods.
      2. Maximum Gap Clearance: Install doors and frames such that gap clearances do not exceed the measurements listed below for any application. These clearances comply with NFPA requirements for smoke and fire rated openings:
         a. Between Door and Frame Head and Jambs: 1/8 inch for wood doors, 3/16 inch for metallic doors.
         b. Between Paired Door Meeting Stiles: 1/8 inch.
         c. Door Undercut: 3/4 inch.
      3. Hardware Mounting Heights: Mount door hardware units at hollow metal door frame manufacturer’s standard heights.
4. Surface Mounted Door Closers: Install surface mounted door closers on room side of openings, except where prohibited by scheduled hardware. Use appropriate arms, spacers, brackets, and accessories to properly install surface mounted door closers. Adjust spring power to the appropriate setting to ensure the doors reliably close under normal operating conditions. Utilize the following installation methods to install closers:
   a. Metallic doors: Drill and tap holes and install closers using template machine screws. Self drilling and tapping screws are prohibited.
   b. Reinforced wood doors and wood frames: Drill pilot holes and install closers using threaded to the head wood screws. Self-piloting screws are prohibited.
   c. Non-Reinforced wood doors: Drill holes and install closers using through bolt fasteners.
5. Wall Mounted Door Stops And Holders
   a. Locate wall mounted door stops at the appropriate height and location to properly contact protruding door trim.
   b. Where indicated in the HW Sets, mount floor stops at exterior doors as a wall stop.
6. Gasketing: Install gasketing to provide a continuous seal around the perimeter of the opening. Install soffit mounted hardware using the proper brackets, spacers, and accessories to allow proper installation without cutting or notching gasketing material or mounting channels.
7. Overlapping Astragals:
   a. Where overlapping astragals are scheduled on out-swinging doors, provide for mounting on the pull-side of the active leaf. Otherwise, provide for mounting on the push-side of the inactive leaf.
   b. Notching astragal is not acceptable. Where strike lip conflicts with astragal, provide strike as specified in “Locks and Latches” article of this section.
8. Thresholds and Saddles: Trim, cut, and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Thresholds and saddles shall be set in full bed of butyl rubber sealant.

3.03 FIELD QUALITY CONTROL
   A. Architectural Hardware Consultant: Architect will engage a qualified Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
   B. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.04 ADJUSTING
   A. After building HVAC system is balanced and adjusted, conduct final adjustment of door closers. Verify spring power of the surface mounted door closer is properly adjusted to close and latch the door and to comply with the opening force requirements of ANSI A117.1 as follows:
      1. Doors with Closers shall take five (5) seconds to close from 90 degrees to 12 degrees.
      2. Interior, non-fire rated swinging doors shall open with a maximum of 5 lbs of pressure.
      3. Exterior doors shall open with the minimum amount of pressure required to positively close and latch the door.

3.05 CLEANING AND PROTECTION
   A. Clean adjacent surfaces soiled by door hardware installation.
   B. Clean operating items as necessary to restore proper function and finish.
   C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.06 SCHEDULE
   A. General: See Section 08 7100 Door Hardware Schedule
      1. The schedule of hardware sets shall be considered a guide and the supplier is cautioned to refer to general conditions, special conditions, and the full requirements of this section. It shall be the hardware supplier’s responsibility to furnish all required hardware.
2. Where items of hardware are not definitely or correctly specified and are required for completion of the Work, a written statement of such omission, error, conflict, or other discrepancy shall be sent to the Architect, prior to date specified for receipt of bids, for clarification by addendum.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Insulating glass units.
   B. Glazing units.
   C. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS
   A. Section 08 1213 - Hollow Metal Frames: Glazed borrowed lites.
   B. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.
   C. Section 08 4313 - Aluminum-Framed Storefronts: Infill panels furnished as part of storefront assembly.

1.03 REFERENCE STANDARDS
   D. GANA (GM) - GANA Glazing Manual; 2009.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
   C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
   D. Samples: Submit two samples 12 by 12 inch in size of glass units, showing coloration and design.
   E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE
   A. Perform Work in accordance with GANA (GM), GANA (SM), and IGMA TM-3000 for glazing installation methods.
   B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of experience.
   C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.06 FIELD CONDITIONS
   A. Do not install glazing when ambient temperature is less than 40 degrees F.
   B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY
   A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.01 GLASS MATERIALS

2.02 GLAZING COMPOUNDS

A. Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, and G, Shore A hardness of 10 to 20; black color.

B. Polysulfide Sealant: Two component; chemical curing, non-sagging type; ASTM C920, Type M, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

C. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.03 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Silicone, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

D. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air barrier and vapor retarder seal; overall inch size to fit glazing channel.

E. Glazing Clips: Manufacturer's standard type.

F. Infill Panels: See Section 08 4313 Aluminum-Framed Storefronts.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

3.03 INSTALLATION, GENERAL

A. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer’s instructions.

B. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

E. Install infill panels with same method as glazing within same storefront unit.
3.04 INSTALLATION - WET/DRY GLAZING METHOD (TAPE AND SEALANT)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.

B. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.

C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

D. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.

E. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.

F. Fill gaps between pane and applied stop with butyl type sealant to depth equal to bite on glazing, to uniform and level line.

G. Carefully trim protruding tape with knife.

3.05 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove non-permanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer’s written recommendations.

END OF SECTION
SECTION 09 2116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.
B. Metal stud wall framing.
C. Acoustic insulation.
D. Gypsum wallboard.
E. Joint treatment and accessories.
F. Textured finish system.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.
B. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
C. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
D. Section 07 9513 - Expansion Joint Cover Assemblies: Covering joints allowing larger movement than control joints.

1.03 REFERENCE STANDARDS

F. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
K. ASTM E413 - Classification for Rating Sound Insulation; 2016.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
C. Samples: Submit two samples of gypsum board finished with proposed texture application, 12 by 12 inches in size, illustrating finish color and texture.
PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES
A. Provide completed assemblies complying with ASTM C840 and GA-216.
B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2.02 METAL FRAMING MATERIALS
A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. Studs: “C” shaped with flat or formed webs.
   2. Runners: U shaped, sized to match studs.
B. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 4000.
C. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and braced with continuous bridging both sides.

2.03 BOARD MATERIALS
A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces, unless otherwise indicated.
   2. Thickness:
   3. Paper-Faced Products:
      b. Georgia-Pacific Gypsum; ToughRock.
      c. National Gypsum Company; Gold Bond BRAND Gypsum Board.
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES
A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 5 1/2 to 6 inch.
B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
   1. Products:
      d. Substitutions: See Section 01 6000 - Product Requirements.
C. Smoke and Acoustic Sealant: Water based acrylic latex dispersion, gun grade or spray, Class A Fire Rating; do not use solvent-based non-curing butyl sealant.
   1. Products:
      d. Substitutions: See Section 01 6000 - Product Requirements.
D. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.
2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
3. Expansion Joints: See Section 07 9513 Expansion Joint Cover Assemblies.

E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

F. Textured Finish Materials: Latex-based compound; plain.

G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure in all locations.
   2. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.

C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

D. Blocking: Install wood blocking for support of:
   1. Wall mounted cabinets.
   2. Plumbing fixtures.
   3. Wall mounted door hardware.
   5. Video and audio equipment.
   6. Pencil sharpeners.
   7. Adjustable shelf brackets.

3.03 ACOUSTIC AND SMOKE ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic and Smoke Sealant: Install as follows:
   1. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.
   2. Pack space between top of wall track and metal deck flutes using rock wool. Seal both sides with spray sealant.

3.04 BOARD INSTALLATION

A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Non-Rated: Install gypsum board perpendicular to framing, with ends and edges occurring over firm bearing.
   1. Exception: Tapered edges to receive joint treatment at right angles to framing.

C. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
1. Not more than 30 feet apart on walls over 30 feet long.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.06 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls to receive textured finish.
   2. Level 2: Behind cabinetry, and on board to receive FRP finish.
   3. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

3.07 TEXTURE FINISH

A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer’s instructions.

B. Texture Required: Very light orange peel to match existing building texture.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION
PART 1  GENERAL

1.01  SECTION INCLUDES
A.  Metal lath for cement plaster.

1.02  RELATED REQUIREMENTS
A.  Section 06 1000 - Rough Carpentry: Sheathing on exterior walls.
B.  Section 07 2500 - Weather Barriers: Weather barrier under exterior plaster and stucco.
C.  Section 09 2400 - Cement Plastering.

1.03  REFERENCE STANDARDS
B.  ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
C.  ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.

1.04  SUBMITTALS
A.  See Section 01 3000 - Administrative Requirements, for submittal procedures.
B.  Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.

1.05  QUALITY ASSURANCE
A.  Installer Qualifications: Company specializing in performing the work of this section a minimum three years experience.

PART 2  PRODUCTS

2.01  LATH
   1.  Weight: To suit application and as specified in ASTM C841 or ASTM C1063 for framing spacing.
B.  Corner Mesh: Formed sheet steel, minimum 0.018 inch thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch size; same finish as lath.
C.  Strip Mesh: Expanded metal lath, same weight as lath, 2 inch wide by 24 inch long; same finish as lath.
D.  Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, and maximum possible lengths.
   1.  Material: Formed sheet steel with rust inhibitive primer, expanded metal flanges.
   5.  Expansion Joints: Accordion profile with factory-installed protective tape, 2 inch wide flanges.
   6.  Control Joints: Accordion profile with factory-installed protective tape, 2 inch flanges.

2.02  ACCESSORIES
A.  Anchorage: Tie wire and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.
B.  Fasteners: Self-piercing tapping screws; ASTM C1002 or ASTM C954.
C. Washers: Galvanized washers, 1 1/4 inch diameter, with deformed shape to contain fastener head and 4 holes to engage cement plaster.
   1. Product: Grip-Plate Flat Washer manufactured by Rodenhouse Inc. or approved equal.
D. Tie Wire: Annealed galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify that substrates are ready to receive work and conditions are suitable for application.
   C. For exterior plaster and stucco on stud walls, verify that weather barrier has been installed over sheathing substrate completely and correctly.
   D. Do not begin until unacceptable conditions have been corrected.
   E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION - GENERAL
   A. Install metal lath and furring for Portland cement plaster in accordance with ASTM C1063.

3.03 CONTROL AND EXPANSION JOINT INSTALLATION
   A. Locate joints as indicated on Drawings and comply with ASTM C1063.
   B. Install expansion joints where an expansion joint occurs in base exterior wall.

3.04 LATH INSTALLATION
   A. Apply lath taut, with long dimension perpendicular to supports.
   B. Lap ends minimum 1 inch. Secure end laps with tie wire where they occur between supports.
   C. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.
   D. Place corner bead at external wall corners; fasten at outer edges of lath only.
   E. Place base screeds at termination of plaster areas; secure rigidly in place.
   F. Place 4 inch wide strips of lath centered over junctions of dissimilar backing materials, and secure rigidly in place.
   G. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.

3.05 TOLERANCES
   A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet.

END OF SECTION
SECTION 09 2400 - PORTLAND CEMENT PLASTERING

PART 1  GENERAL

1.01 SECTION INCLUDES
   A. Portland cement plaster for installation over metal lath.

1.02 RELATED REQUIREMENTS
   A. Section 05 4000 - Cold-Formed Metal Framing: Structural metal framing for plaster.
   B. Section 06 1000 - Rough Carpentry: Wood sheathing for plaster.
   C. Section 09 2236.23 - Metal Lath: Metal furring and lathing for plaster.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
   B. Product Data: Provide data on plaster materials, characteristics and limitations of products specified.

1.05 QUALITY ASSURANCE
   A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.06 MOCK-UP
   A. Construct mock-up of exterior wall, 3 feet long by 3 feet wide, illustrating surface finish.

1.07 FIELD CONDITIONS
   A. Do not apply plaster when substrate or ambient air temperature is under 50 degrees F or over 80 degrees F.

PART 2  PRODUCTS

2.01 PORTLAND CEMENT PLASTER ASSEMBLIES
   A. Exterior Stucco: Portland cement plaster system, made of finish and scratch coat and reinforcing mesh.

2.02 PLASTER MATERIALS
   A. Portland Cement, Aggregates, and Other Materials: In accordance with ASTM C926.
   B. Premixed Base Coat: Mixture of cement, aggregate, and proprietary admixtures for scratch coat, installed in accordance with ASTM C926.
   C. Premixed Finish Coat: Same product as base coat.
   D. Water: Clean, fresh, potable and free of mineral or organic matter that could adversely affect plaster.

2.03 METAL LATH
   A. Metal Lath and Accessories: As specified in Section 09 2236.23.
   B. Beads, Screeds, and Joint Accessories: As specified in Section 09 2236.23.

2.04 PLASTER MIXES
   A. Over Metal Lath: Two-coat application, mixed and proportioned in accordance with ASTM C926.
   B. Premixed Plaster Materials: Mix in accordance with manufacturer’s instructions.
   C. Mix only as much plaster as can be used prior to initial set.
   D. Mix materials dry, to uniform color and consistency, before adding water.
   E. Protect mixtures from freezing, frost, contamination, and excessive evaporation.
F. Do not retemper mixes after initial set has occurred.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify the suitability of existing conditions before starting work.
B. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

3.02 PLASTERING

A. Apply premixed plaster in accordance with manufacturer's instructions.
B. Apply plaster in accordance with ASTM C926.
C. Two-Coat Application:
   1. Apply first coat to nominal thickness of 1/2 inch.
   2. Apply finish coat to nominal thickness of 1/8 inch.
D. Locate contraction and expansion joints at locations shown on Drawings.
E. Moist cure base coat.
F. After curing, dampen previous coat prior to applying finish coat.
G. Finish Texture: Struck off to a consistent finish.
H. Avoid excessive working of surface. Delay troweling as long as possible to avoid drawing excess fines to surface.
I. Moist cure finish coat for minimum period of 48 hours.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Acoustical units.

1.02 RELATED REQUIREMENTS
   A. Section 21 1300 - Fire-Suppression Sprinkler Systems: Sprinkler heads in ceiling system.
   B. Section 23 3700 - Air Outlets and Inlets: Air diffusion devices in ceiling.
   C. Section 26 5100 - Interior Lighting: Light fixtures in ceiling system.
   D. Section 28 4600 - Fire Detection and Alarm: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS
   D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.04 ADMINISTRATIVE REQUIREMENTS
   A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
   B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on suspension system components.

1.06 QUALITY ASSURANCE
   A. Fire-Resistive Assemblies: Complete assembly listed and classified by UL (FRD) for the fire resistance indicated.
   B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum seven years experience.
   C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum seven years experience.

1.07 FIELD CONDITIONS
   A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS
   A. Acoustical Units - General: ASTM E1264, Class A.
      1. Units for Installation in Fire-Rated Suspension System: Listed and classified for the fire-resistive assembly as part of suspension system.
   B. Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
      1. Size: 24 by 24 inches.
      2. Thickness: 3/4 inches.
4. Edge: Beveled Tegular.
5. Surface Color: White.
7. Suspension System: Exposed grid.
8. Products:
   c. Substitutions: See Section 01 6000 - Product Requirements.

C. Acoustic Clouds: Wood and Cement Fiber Acoustic Panels composed of Aspen wood fibers bonded with inorganic hydraulic cement.
2. Panel Thickness: 2 inches.
5. NRC Coefficient Range: .58 to .62, determined in accordance with ASTM E1264.
6. Edge Profile: Square.
7. Corner Style: Radius.
8. Suspension System: Concealed grid, Type Standard.
9. Products:
   a. Tectum Inc.; Radius Cloud Panels.
   b. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SUSPENSION SYSTEM(S)

A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and safety clips as required.
B. Fire-Rated and Seismic Rated Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
   1. Profile: Tee; 15/16 inch wide face.
   2. Construction: Double web.
   6. Products:
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
B. Acoustic Cloud Safety Clips: Galvanized 1-9/16 by 5-1/2 inch bent sheet metal clips screw anchored to back of adjacent panels and spanning over top of suspended tee grid.
   1. Wire Ties: No. 12 galvanized wire.
C. Perimeter Moldings: Same material and finish as grid.
   1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Miter corners.

K. Acoustic Cloud: Align suspension system with spacing of slots in the back of panels. Support with minimum two main runners and four wire hangers. Extend suspension grid to within 4 inches of cloud perimeter.

3.02 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.

G. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

H. Install safety clips on acoustic cloud wood panels 2 inches from end of suspension grid and at 24 inches on center.
   1. Use wire ties to attach safety clips.

3.03 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION
SECTION 09 6813 - TILE CARPETING

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Carpet tile, fully adhered.
1.02 RELATED REQUIREMENTS
   A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.
1.03 REFERENCE STANDARDS
   B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
   C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
   D. Submit two, 3 inch long samples of edge strip and wall base.
   E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      1. See Section 01 6000 - Product Requirements, for additional provisions.
      2. Extra Carpet Tiles: 100 sq ft of each color and pattern installed.
1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum seven years experience.
   B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years experience and approved by carpet tile manufacturer.
1.06 FIELD CONDITIONS
   A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS
2.01 MANUFACTURERS
   A. Tile Carpeting:
   B. Walk Off Mat: Product will be supplied by Owner and installed by Contractor.
2.02 MATERIALS
   A. Tile Carpeting: Level Loop, manufactured in one color dye lot.
      1. Tile Size: 24 by 24 inch, nominal.
      2. Color: two colors from manufacturer's standard selection.
      3. Maximum Electrostatic Charge: 3 Kv. at 20 percent relative humidity.
      4. Stitches: 8.2 per inch.
      5. Pile Weight: 18 oz/sq yd.
   B. Walk Off Mat: Tufted, manufactured in one color dye lot.
      1. Product: Abrasive Action II #02578 manufactured by Tandus Centiva.
      2. Tile Size: 24 by 24 inch, nominal.
2.03 ACCESSORIES
A. All accessories required for installation of carpet are supplied by Contractor.
B. Sub-Floor Filler: cementitious; type recommended by flooring material manufacturer.
C. Edge Strips: Rubber, match wall base color.
   1. Profiles: Ramp reducers or edges as appropriate for conditions.
   2. Manufacturers:
      a. Burke Flooring: www.burkemercer.com
      b. Johnsonite, a Tarkett Company: www.johnsonite.com
      d. Substitutions: See Section 01 6000 - Product Requirements.
D. Primers: For porous surfaces or concrete curing and sealing compounds as recommended by carpet tile manufacturer.
E. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; RS pre-applied adhesive for peel and stick installation type.
F. Wall Base: See Section 09 6500 Resilient Flooring and Base.

2.04 RESILIENT BASE
A. Resilient Base: ASTM F1861, Type TV, vinyl, thermoplastic; Group I Solid, top set Style B, Cove.
   1. Manufacturers:
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Height: 4 inch.
   3. Thickness: 0.080 inch thick.
   5. Length: Roll.
   6. Color: Two colors as selected from manufacturer's full range.
   7. Accessories: Premolded external corners and end stops.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
B. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
   1. Test in accordance with ASTM F710.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION
A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
D. Vacuum clean substrate.
E. If needed to seal porous surfaces, apply primer per manufacturer's recommendations.
3.03 INSTALLATION
   A. Starting installation constitutes acceptance of sub-floor conditions.
   B. Install carpet tile in accordance with manufacturer's instructions.
   C. Blend carpet from different cartons to ensure minimal variation in color match.
   D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
   E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
   F. Locate change of color or pattern between rooms under door centerline.
   G. Fully adhere carpet tile to substrate.
   H. Trim carpet tile neatly at walls and around interruptions.
   I. Complete installation of edge strips, concealing exposed edges.

3.04 RESILIENT BASE
   A. Fit joints tightly and make vertical. Maintain minimum dimension of 36 inches between joints.
   B. Miter internal corners. At external corners and end stops use premolded units.
   C. Install base on solid backing. Bond tightly to wall surfaces.

3.05 CLEANING
   A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
   B. Clean and vacuum carpet surfaces.

END OF SECTION
SECTION 09 9113 - EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of steel lintels.
   2. Exposed surfaces of steel roof deck.
   3. Mechanical and Electrical:
      a. On the roof and outdoors, paint equipment that is exposed to weather or to view, except factory-finished materials.
D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Stainless steel and anodized aluminum.
   6. Concrete unit masonry and architectural concrete.
   7. Prefinished metal trim, flashing and coping.
   8. Glass.
   9. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Shop-primed items.
B. Section 09 9123 - Interior Painting.

1.03 REFERENCE STANDARDS

C. SSPC-SP 1 - Solvent Cleaning; 2015.
D. SSPC-SP 11 - Power Tool Cleaning to Bare Metal.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
C. Samples: Submit two painted samples, illustrating selected colors for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 8 by 8 inch in size.
D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon of each color in new unopened container; store where directed.
3. Label each container with color and mix code and use locations in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum seven years experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.

B. Provide panel, 3 feet long by 2 feet wide, illustrating paint color, texture, and finish.

C. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Clear Finishes: 65 degrees F for exterior, unless required otherwise by manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

1. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.

B. Paints:


C. Transparent Finishes:

D. Primer Sealers: Same manufacturer as top coats.
E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each paint material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Colors: To be selected from manufacturer's full range of available colors.
   1. Selection to be made by Architect after award of contract.
   2. Allow for minimum of two colors for each system, unless otherwise indicated, without additional cost to Owner.

2.03 PAINT SYSTEMS - EXTERIOR

A. Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including factory primed metal, bare metal and galvanized metal and stucco surfaces.
   1. Two top coats and one coat primer unless already factory primed.
   2. Top Coat(s): Exterior Alkyd Enamel; MPI #94 over metal.
   3. Top Coat(s): Exterior Pigmented Elastomeric, Water Based;MPI #113, over stucco.
      a. Products:
         1) Behr Premium Elastomeric Masonry, Stucco and Brick Paint [No. 68].
         2) Diamond Vogel Permaflex Elastomeric Coating.
         3) Pratt & Lambert Pro-Hide Gold Exterior Masonry Acrylic Elastomeric Topcoat.
         4) Sherwin Williams SherLastic Elastomeric.
         5) Valspar Duramax Elastomeric Masonry, Stucco & Brick Paint.
         6) Substitutions: Section 01 6000 - Product Requirements.
   4. Top Coat Sheen:
      a. Flat: MPI gloss level 1; use this sheen over stucco surfaces.
      b. Semi-Gloss: MPI gloss level 5; use this sheen over metal surfaces.
   5. Primer: As specified under "PRIMERS" below.

B. Transparent Finish on Glulam Beams:
   1. 3 top coats, no stain.
   2. Top Coats: Varnish, Exterior, Water Based; MPI #194.
   3. Top Coat Products:
      a. Old Masters; Exterior Water-Based Spar-Urethane.
      b. Sherwin Williams, Minwax; Water Based Helmsman Spar Urethane.
   4. Top Coat Sheen:
      a. Satin: MPI gloss level 4; use this sheen at all locations.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Alkali Resistant Water Based Primer; MPI #3 use on stucco surfaces.
   2. Anti-Corrosive Alkyd Primer for Metal; MPI #79, use on bare metal.
   3. Alkyd Primer for Metal, surface tolerant; MPI #23, use for touch up of factory primer.
   4. Alkyd Primer for Galvanized Metal; MPI #26.
2.05 ACCESSORY MATERIALS
A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
B. Patching Filler for Metal Surfaces: Modified Alkyd.
   1. Products:
      b. Substitutions: Section 01 6000 - Product Requirements.

PART 3 EXECUTION
3.01 EXAMINATION
A. Do not begin application of paints and finishes until substrates have been properly prepared.
B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
D. Test shop-applied primer for compatibility with subsequent cover materials.
E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Exterior Plaster and Stucco: 12 percent.
   2. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION
A. Clean surfaces thoroughly and correct defects prior to application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove surface appendages, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
D. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
E. Exterior Plaster (Stucco): Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
F. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
G. Ferrous Metal:
   2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and power tool cleaning to bare metal according to SSPC-SP11. Protect from corrosion until coated.
H. Exterior Wood to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer.

3.03 APPLICATION
A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
E. Apply each coat to uniform appearance.
F. Elastomeric coating shall be backrolled if applied with sprayer to ensure uniform thickness over stucco surface.
G. Apply at rate recommended by manufacturer. Final elastomeric coating thickness shall be 12 mils dry film minimum.
H. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.
I. Sand wood surfaces lightly between coats to achieve required finish.
J. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
K. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL
A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.
B. Owner will provide field inspection.
C. Applied dry film thickness will be tested.

3.05 CLEANING
A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION
A. Protect finishes until completion of project.
B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION
SECTION 09 9123 - INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

   A. Surface preparation.
   B. Field application of paints.
   C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
      1. Exposed surfaces of steel roof deck.
      2. Glulam beams.
      3. Hollow metal door and window frames.
      4. Mechanical and Electrical:
         a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
   D. Do Not Paint or Finish the Following Items:
      1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
      2. Items indicated to receive other finishes.
      3. Items indicated to remain unfinished.
      4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
      5. Stainless steel and anodized aluminum.
      6. Floors, unless specifically indicated.
      7. Glass.
      8. Acoustical materials, unless specifically indicated.
      9. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

   A. Section 05 5000 - Metal Fabrications: Shop-primed items.
   B. Section 09 9113 - Exterior Painting.

1.03 REFERENCE STANDARDS

   C. SSPC-SP 1 - Solvent Cleaning; 2015.
   D. SSPC-SP 11 - Power Tool Cleaning to Bare Metal.

1.04 SUBMITTALS

   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide complete list of products to be used, with the following information for each:
      1. Manufacturer’s name, product name and/or catalog number, and general product category (e.g. “alkyd enamel”).
      2. MPI product number (e.g. MPI #47).
      3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   C. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 8 by 8 inch in size.
   D. Maintenance Materials: Furnish the following for Owner’s use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gallon of each color, in new unopened container; store where directed.
3. Label each container with color, room locations, and mix code in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum seven years experience.
B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

1.06 MOCK-UP
A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
B. Provide panel, 3 feet long by 3 feet wide, illustrating paint color, texture, and finish.
C. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS
A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
C. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
B. Paints:
C. Primer Sealers: Same manufacturer as top coats.
D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL
A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. Supply each paint material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content: Use Low Odor, Low VOC products on interior wall, ceiling and structural surfaces.

C. Colors: To be selected from manufacturer's full range of available colors.
   1. Selection to be made by Architect after award of contract.
   2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
   3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - INTERIOR

A. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
   1. Medium duty applications include doors, door frames, and window frames.
   2. Two top coats and one coat primer.
   3. Top Coat(s): Interior Alkyd; MPI #47.
   4. Top Coat Sheen:
      a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
   5. Primer: As specified under "PRIMERS" below.

B. Medium Duty Vertical and Overhead: Including gypsum board, concrete masonry units, uncoated steel, shop primed steel, and galvanized steel.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #145 and #147.
   3. Top Coat Sheen:
      a. Eggshell: MPI gloss level 3; use this sheen at ceilings.
      b. Semi-Gloss: MPI gloss level 5; use this sheen at walls.
   4. Primer: As specified under "PRIMERS" below.

C. Transparent Finish on Wood.
   1. Top Coat(s): Clear Water Based Varnish; MPI #128, clear satin.
      a. Products:
         1) Minwax Water Based Oil-Modified Polyurethane.
         2) Old Masters Water Based Polyurethane.
         3) Substitutions: Section 01 6000 - Product Requirements.
      b. VOC Content: Less than 276 grams/liter.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Interior Institutional Low Odor/VOC Primer Sealer; MPI #149, for gypsum board.
   2. Anti-Corrosive Alkyd Primer for Metal; MPI #79, for touch up of factory applied primer.
   3. Interior Rust-Inhibitive Water Based Primer; MPI #107, for bare metal.
   4. Interior/Exterior Quick Dry Alkyd Primer for Metal; MPI #76, for touch up of factory applied primer.
   5. Interior Water Based Primer for Galvanized Metal; MPI #134, for electrical conduit and boxes.
6. Bonding Primer, Water Based; MPI #17, for use over existing paint or finishes.

2.05 ACCESSORY MATERIALS
A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
B. Patching Material: Latex filler.
C. Patching Filler for Metal Surfaces: Modified Alkyd.
   1. Products:
      b. Substitutions: Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION
A. Do not begin application of paints and finishes until substrates have been properly prepared.
B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
D. Test shop-applied primer for compatibility with subsequent cover materials.
E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION
A. Clean surfaces thoroughly and correct defects prior to application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or repair existing paints or finishes that exhibit surface defects.
D. Remove surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
E. Seal surfaces that might cause bleed through or staining of topcoat.
F. Masonry: Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
H. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
I. Ferrous Metal:
   2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and power tool cleaning to bare metal according to SSPC-SP11. Protect from corrosion until coated.
J. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Sand lightly between coats.

3.03 APPLICATION
A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
G. Sand wood and metal surfaces lightly between coats to achieve required finish.
H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING
A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION
A. Protect finishes until completion of project.
B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION
SECTION 10 1400 - SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Room and door signs.
   B. Interior directional and informational signs.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
   C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
      1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
      2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
      3. Submit for approval by Owner through Architect prior to fabrication.
   D. Samples: Submit one sample of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
   E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
   F. Verification Samples: Submit samples showing colors specified.

1.04 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Package signs as required to prevent damage before installation.
   B. Package room and door signs in sequential order of installation, labeled by floor or building.
   C. Store tape adhesive at normal room temperature.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS
   A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
   B. Room and Door Signs: Provide a sign for locations indicated below.
      1. Sign Type: Flat signs with applied character panel media as specified.
      2. Classroom Doors: Identify with room names and numbers to be determined later, not those shown on the drawings.
      3. Office Doors: Identify with room names and numbers to be determined later, not those shown on the drawings; in addition, provide ‘window’ section for replaceable occupant name, title and discipline on separate lines, ie: Joe Thomas, Instructor, Science.
4. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.

C. Interior Directional and Informational Signs:
   1. Sign Type: Same as room and door signs.
   2. Sizes: As indicated on the Drawings.
   3. Wording of signs is scheduled on drawings.

D. Traffic Signs: To match campus standards; locate where indicated on drawings.

### 2.02 SIGN TYPES

A. Flat Signs: Signage media in matching plastic frame. Match existing signage.
   1. Sign Size: As indicated on Drawings.
   2. Provide “tactile” signage, with letters raised minimum 1/32 inch and Grade II braille.
   3. Character Height: 7/8 inch.
   5. Room Signs with Changeable Names: Outer band is 1/8 inch wide, color to match sign body. Middle band to be part of removable plastic sign insert with clear polycarbonate overlay at lower half to cover interchangeable text insert. Inner border band to be 1/16 inches wide and raised and a color as selected by the Architect.
   6. Wall Mounting of One-Sided Signs: Tape adhesive except use clear silicone adhesive on window glass locations.

B. Color and Font:
   2. Character Case: Upper and lower case (title case).

### 2.03 TACTILE SIGNAGE MEDIA

A. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
   1. Total Thickness: 1/8 inch.

### 2.04 ACCESSORIES

A. Tape Adhesive: Double sided tape, permanent adhesive.
B. Silicone Adhesive: Loctite Clear Silicone Waterproof Sealant, www.loctiteproducts.com, or Permatex or other manufacturer's equal product.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

#### 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install neatly, with horizontal edges level.
C. Protect from damage until Substantial Completion; repair or replace damaged items.

**END OF SECTION**
SECTION 10 2601 - WALL AND CORNER GUARDS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Corner guards.

1.02 REFERENCE STANDARDS
B. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Wall and Corner Guards:
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS
A. Corner Guards - Surface Mounted:
   1. Material: High impact vinyl with full height extruded aluminum retainer.
   2. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   3. Width of Wings: 2 inches.
   5. Color: As selected from manufacturer's standard colors.
   7. Preformed end caps.

2.03 ACCESSORIES
A. Fasteners: ASTM C1002; self-piercing tapping screws, corrosion resistant.

2.04 FABRICATION
A. Fabricate components with tight joints, corners and seams.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION
A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall finishes.
B. Position corner guard above wall base and extend additional 48 inches up wall.
3.03 TOLERANCES
   A. Maximum Variation From Required Height: 1/4 inch.
   B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 SCHEDULE
   A. Where indicated on Drawings.

END OF SECTION
SECTION 10 4400 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fire extinguishers.
B. Fire extinguisher cabinets.
C. Accessories.

1.02 RELATED REQUIREMENTS
A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS
C. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, and anchorage details.
C. Shop Drawings: Indicate cabinet physical dimensions and rough-in measurements for recessed cabinets.

1.05 FIELD CONDITIONS
A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Fire Extinguishers:
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE EXTINGUISHERS
A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   2. Class: A:B:C type.
   3. Finish: Baked polyester powder coat, red color.
   4. Temperature range: Minus 65 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS
A. Cabinet Configuration: Semi-recessed type.
   1. Interior nominal dimensions of 9 1/2 to 10 1/2 inch wide by 24 inch high by 6 inch deep.
   2. Trim: Rolled edge returned to wall surface, with 2 1/2 to 3 inch projection, 1 3/4 inch wide face.
3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.

B. Door: 1/2 inch thick hollow metal with pull, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with continuous piano hinge. Provide roller type catch.

C. Weld, fill, and grind components smooth.

D. Finish of Cabinet Exterior Trim and Door: Baked enamel, white color.

E. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install cabinets plumb and level in wall openings, 28 inches from finished floor to inside bottom of cabinet.

B. Secure rigidly in place.

C. Place extinguishers in cabinets.

END OF SECTION
SECTION 11 5215 - AUDIO-VISUAL EQUIPMENT SUPPORTS

PART 1 - GENERAL

1.01 SECTION INCLUDES
   A. Flat screen display mounting unit.

1.02 SCOPE OF WORK
   A. Mounting unit and display monitor will be supplied by Owner. Both shall be installed by Contractor.

1.03 RELATED REQUIREMENTS
   A. Section 06 1000 - Rough Carpentry: Concealed wood blocking for supports.
   B. Section 26 0537 - Electrical Boxes: Power and data receptacle boxes.

1.04 REFERENCE STANDARDS
   A. VESA FDMI- Video Electronics Standards Association, Flat Display Mounting Interface Standard.

1.05 QUALITY ASSURANCE
   A. Warranty: 5 years full replacement warranty covering defects in materials and workmanship.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
   A. Mounts for Large Flat Screen Displays: flat wall mount.
      4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CONSTRUCTION
   A. Flat Wall Mount: VESA compliant, open frame, low profile.
      1. Adjustability: Horizontal sliding brackets, 12 inch adjustment minimum to compensate for off center stud spacing; plus or minus 0.5 inch vertical adjustment for leveling.
      2. Size: Capable of supporting 46 to 70 inch flat screen display.
      3. Weight Capacity: 150 pounds minimum.
   B. Materials: Heavy gauge steel with MIG welds.
      2. Color: Black.
   C. Mount manufacturer shall provide all anchoring devices and fastener accessories as required for a complete installation.

PART 3 - EXECUTION

3.01 EXAMINATION
   A. Examine walls and locations for the installation of the mounting unit. Confirm backing is in place, as required by manufacturer and there are clearances around units for operation of mount function. Provide for proper clearance of outlets and connection data ports.
   B. Should conflicts exist, do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION
   A. Follow manufacturer's printed instructions for installation.
   B. Install in locations and at mounting heights indicated or as directed by Architect.
   C. Prepare installation for proper operation as required by type and size of mount and style and to comply with manufacturer's instructions.
      1. In acoustic rated wall construction, maintain integrity of rated assembly.
D. Fasten mounting frame to structure for square and plumb installation; adjust brackets as needed for final monitor horizontal and level location.

END OF SECTION
SECTION 11 5300 - LABORATORY EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Contractor-furnished laboratory equipment including CFOI equipment installed by Owner.
   B. Service fittings and outlets.

1.02 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide equipment dimensions and construction, equipment capacities, physical
      dimensions, utility and service requirements and locations, point loads and finishes.
   C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been
      completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE
   A. Manufacturer: Company specializing in manufacturing the types of products specified in this
      section, with minimum ten years of experience.

1.04 REGULATORY REQUIREMENTS
   A. Conform to UL requirements for fabrication and installation of electrical equipment.

1.05 WARRANTY
   A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
   B. Correct defective Work within a one year period after Date of Substantial Completion.
   C. Provide one year manufacturer warranty for defects in material or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Laboratory Equipment: Fume Hood

2.02 HOOD COMPONENTS
   A. Superstructure: Free standing rigid frame structure of steel angle supporting exterior panels
      and interior liner and baffle panels with access panels for service piping and valves. Overall
      nominal width shall be 5 feet and nominal depth shall be 31 inches. Filler panels between top of
      hood and room ceiling are not required.
   B. Installation Accessories: Provide all rough-in frames, anchors, supports, accessories and
      closure trim required for complete installation.
   C. Service Fittings and Accessories: None required except provide service chases and access
      panels to allow potential future installation.
   D. Electrical: Hood superstructure shall be prewired with two total, duplex, 120V receptacles with
      ground fault interruption, one at each side front panel and overhead light fixture with exterior
      switch.
   E. Work Surface: 1 1/4 inch thick molded epoxy resin made in the form of a watertight pan, 3/8
      inch deep to contain spillage with a 6 inch wide safety ledge across the front surface and an
      epoxy cupsink at left rear of work surface and cutout for airflow from chemical storage cabinet
      below.
   F. Exterior Panels: Steel with electrostatic powder coat finish.
   G. Exterior Panels: Optional molded fiberglass reinforced polyester exterior panels are acceptable.
   H. Liner: Fiberglass reinforced polyester fastened with stainless steel screws covered with plastic
      heads.

10-04-27 / LCCC ACC Classroom  11 5300 - 1  LABORATORY EQUIPMENT Addition
I. Duct Collar: 12 inch diameter polyethylene bell-mouthed duct collar shall be located in the top of the plenum chamber.

J. Alarms: Provide low static pressure alarm capable of sensing static pressure in the exhaust duct above the hood using a differential pressure switch. Alarm shall have visible light and audible buzzer with silencing mode. Light shall remain visible while alarm condition exists.

2.03 ACID STORAGE CABINETS

A. Steel frame and exterior panels with electrostatic powder coat finish to match fume hood superstructure. 30 inch nominal width and 22 inch nominal depth with rear filler panel to match fume hood depth.

B. Completely lined with corrosion-resistant polyethylene liner material; stainless steel fasteners for all connections and hardware inside cabinets.

C. Shelves: Removable, same material as cabinet, covered with corrosion-resistant liner.

D. Bottom Pan: Liquid-tight liner covering entire bottom of acid-storage cabinet.

E. Vents: Comply with SEFA 1.2.
   1. Locate acid-storage cabinet vents in accordance with manufacturer’s instructions.
   2. Vent base cabinets through work surface with manufacturer’s vent kit.
   3. Vent each acid-storage cabinet separately.
   4. When acid-storage cabinets are installed below fume hoods, provide louvered cabinet doors.
   5. Seal penetrations with chemical-resistant sealant.

2.04 SOLVENT STORAGE CABINETS

A. Steel frame and exterior panels with electrostatic powder coat finish to match fume hood superstructure. 30 inch nominal width and 22 inch nominal depth with rear filler panel to match fume hood depth.

B. Construct to NFPA 30 and applicable OSHA requirements.

C. Fire Resistance: Maximum internal temperature of 325 degrees F when subjected to a ten-minute fire test and using a standard time-temperature curve in accordance with NFPA 30.

D. Shelves: Full depth, adjustable.

E. Bottom Pan: 2 inches deep, liquid-tight pan covering entire bottom of cabinet.

F. Cabinet Hardware: UL-listed, self-closing, latching doors synchronized so that both doors will always fully close; three-point latching system in right-hand leaf of every pair of doors and equip latching system with lock; fusible-link hold-open device that releases the door to close when ambient temperature exceeds 165 degrees F.

G. Vents: Provide venting capable of achieving ten air changes per hour.
   1. Tie into building fume hood exhaust system above superstructure. Do not vent through worksurface into fume hood chamber.
   2. Vent Connections: 1-1/2 inch minimum diameter, corrosion-resistant piping having flame spread index of 25 or less when tested in accordance with ASTM E84.
   3. Provide minimum of two vents with fire baffle per cabinet.

H. Signage: Provide manufacturer's standard signage reading "FLAMMABLE - KEEP FIRE AWAY" or similar message in bright red color.

2.05 FUME HOOD PERFORMANCE REQUIREMENTS

A. Air Flow Type: Restricted bypass for use with variable air volume exhaust system.

B. Opening Type: Vertical sash with minimum 60 feet per minute air flow in all positions.

C. Air Foil and Baffles: Streamlined airfoil shall be integral at bottom of hood opening to direct air stream across work surface and prevent back flow of air. Fixed rear baffle shall distribute flow of air into and through the hood.
PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that utility connections, rough-in frames, anchors and supports are accurately placed and deliver building services at specified characteristics and/or within acceptable functional ranges.
B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
C. Verify that rough-in frames, anchors and supports are accurately placed.

3.02 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Install fume hood plumb and level. Anchor equipment securely in place.
C. Coordinate installation of mechanical and electrical services.
D. Touch-up minor damaged surfaces caused during installation. Replace damaged components as directed by Architect.

3.03 ADJUSTING
A. Adjust operating equipment to efficient operation.

3.04 CLOSEOUT ACTIVITIES
A. Final Acceptance: Remove labels, fingerprints, and clean all surfaces both inside and out. Repair any marred or damaged surfaces that affect appearance, such as both interior and exterior of cabinets in a manner acceptable to Owner. Replace any parts that cannot be repaired in such a manner.
B. Test and certify air flow through hood superstructure and chemical storage cabinet meets performance requirements.

END OF SECTION
SECTION 12 2400 - WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Window shades and accessories.

1.02 RELATED REQUIREMENTS
   A. Section 06 1000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 ADMINISTRATIVE REQUIREMENTS
   A. Coordination:
   B. Sequencing:
      1. Do not fabricate shades until field dimensions for each opening have been taken.
      2. Do not install shades until final surface finishes and painting are complete.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
   C. Shop Drawings: Include shade schedule indicating size, location and keys to details.
   D. Selection Samples: Include fabric samples in full range of available colors and patterns.
   E. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than seven years of experience.
   B. Installer Qualifications: Company specializing in performing work of this type with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
   B. Handle and store shades in accordance with manufacturer's recommendations.

1.07 FIELD CONDITIONS
   A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Manually Operated Roller Shades:

2.02 WINDOW SHADE APPLICATIONS
   A. Shades at all locations unless noted otherwise: Translucent shades.
      1. Type: Roller shades.
      2. Fabric: synthetic, fiberglass, vinyl or polyester.
      3. Fabric Performance Requirements:
         a. Openness Factor: 5 percent.
         b. Fire Classification: Class A material.
4. Color: As selected by Architect from manufacturer’s full range of colors.

B. Shades at Classroom (Lecture): Dual shades.
   1. Type: Roller shades.
   2. Fabric: synthetic, fiberglass, vinyl or polyester.
   3. Fabric Performance Requirements:
      a. Inner Shade (next to glass) Openness Factor: 5 percent.
      b. Outer Shade Openness Factor: 0 percent.
      c. Fire Classification: Class A material.
   4. Color: As selected by Architect from manufacturer’s full range of colors.

2.03 ROLLER SHADES
A. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories.
   1. Size: Related to window sizes as shown on Drawings.

B. Roller Tubes: As required for type of operation.
   1. Size: Manufacturer's standard, selected for suitability for installation conditions, span, and weight of shades.

C. Hembars: Designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.

D. Manual Operation for Interior Shades: Clutch operated continuous loop; beaded ball chain.

2.04 ACCESSORIES
A. Fascias: Size as required to conceal shade mounting.
   1. Style: As selected by Architect from shade manufacturer’s full selection.
   2. Material and Color: To match shade.

B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.

C. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.05 FABRICATION
A. Fabricate shades to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with 1/4 inch space between bottom bar and window sill.
   2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.

B. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION
3.01 EXAMINATION
A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION
A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.
3.03 INSTALLATION
   A. Install in accordance with manufacturer's instructions and approved shop drawings, using
      mounting devices as indicated.
   B. Installation Tolerances:
      1. Inside Mounting: Maximum space between shade and jamb when closed of \( \frac{1}{8} \) inch.
      2. Maximum Offset From Level: \( \frac{1}{16} \) inch.
   C. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
   D. Adjust level, projection and shade centering from mounting bracket. Verify there is no
      telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING
   A. Clean soiled shades and exposed components as recommended by manufacturer.
   B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES
   A. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's
      personnel.

3.06 PROTECTION
   A. Protect installed products from subsequent construction operations.
   B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
SECTION 210523
GENERAL-DUTY VALVES FOR FIRE PROTECTION 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. Two-piece ball valves with indicators.
   2. Check valves.
   3. Trim and drain valves.

1.3 DEFINITIONS
A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
B. NRS: Nonrising stem.
C. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and weld ends.
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 operating handles or stems as lifting or rigging points.
D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL’s “Online Certifications Directory” under the headings listed below and shall bear UL mark:

   a. Level 1: VQGU - Valves, Trim and Drain.

B. FM Global Approved: Valves shall be listed in its “Approval Guide,” under the headings listed below:

1. Automated Sprinkler Systems:
   a. Indicator posts.
   b. Valves.
      1) Gate valves.
      2) Check valves.
         a) Single check valves.
      3) Miscellaneous valves.

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads for threaded-end valves.
3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.
2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. Description:

1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear or traveling nut.
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.

2.3 CHECK VALVES

A. Description:

3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.

2.4 TRIM AND DRAIN VALVES

A. Ball Valves:

1. Description:

   b. Body Design: Two piece.
   c. Body Material: Forged brass or bronze.
   d. Port size: Full or standard.
   e. Seats: PTFE.
   f. Stem: Bronze or stainless steel.
   g. Ball: Chrome-plated brass.
   h. Actuator: Handlever.
   i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
   j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:

1. Description:

   b. Body Material: Brass or bronze.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

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 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
1. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.

B. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above the pipe center.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

F. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.

G. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
END OF SECTION 210523
SECTION 210553
IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Equipment labels.
   2. Pipe labels.
   3. Valve tags.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
C. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS
A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, 0.032 inch anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
   2. Letter Color: Black.
   4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. 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 thick, with predrilled holes for attachment hardware.

2. **Letter Color**: White.

3. **Background Color**: Black.

4. **Maximum Temperature**: Able to withstand temperatures up to 160 deg F.

5. **Minimum Label Size**: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. **Minimum Letter Size**: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. **Fasteners**: Stainless-steel rivets or self-tapping screws.

8. **Adhesive**: Contact-type permanent adhesive, compatible with label and with substrate.

**C. Label Content**:

Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

### 2.2 PIPE LABELS

**A. General Requirements for Manufactured Pipe Labels**:

Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.

**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 ½”.

**E. Pipe-Label Colors**:

1. **Background Color**: Safety Red.

2. **Letter Color**: White.

### 2.3 VALVE TAGS

**A. Description**:

Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.

1. **Tag Material**: Brass, 0.032 inch or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.

2. **Fasteners**: Brass wire-link chain beaded chain or S-hook.

3. **Valve-Tag Color**: Safety Red.

4. **Letter Color**: White.

**B. Valve Schedules**:

For each piping system, on 8-1/2-by-11-inch 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.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe-Label Locations: 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. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. Near major equipment items and other points of origination and termination.
5. Spaced at maximum intervals of 30 feet along each run. Reduce intervals to 20 feet in areas of congested piping and equipment.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.
3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in “Valve-Tag Size and Shape” Subparagraph below:

1. Valve-Tag Size and Shape:

C. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 210553
SECTION 211313
WET-PIPE SPRINKLER 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. Pipes, fittings, and specialties.
   2. Cover system for sprinkler piping.
   4. Sprinklers.
   5. Pressure gages.
B. Related Requirements:
   1. Section 220517 Sleeve Seals for Plumbing Piping.
   2. Section 220220518 Escutcheons for Plumbing Piping.
   3. Section 230523 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, check, and trim and drain valves.

1.3 DEFINITIONS
A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. Shop Drawings: For wet-pipe sprinkler systems.
   1. Include plans, elevations, sections, and attachment details.
   2. Include diagrams for power, signal, and control wiring.
C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and professional engineer.

B. Design Data:
   1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Field Test Reports:
   1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

1.9 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   1. Notify Architect no fewer than two days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of sprinkler service without Architect's written permission.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   2. NFPA 13R.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.
   1. Fire-hydrant flow tests are not available, and should be obtained by the delegated designer.
   2. Sprinkler system design shall be approved by authorities having jurisdiction.
      a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
      b. Sprinkler Occupancy Hazard Classifications:
         1) Building Service Areas: Ordinary Hazard, Group 1.
         2) Office and Public Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
   c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

4. Maximum Protection Area per Sprinkler: According to UL listing.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Galvanized- and Black-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.


E. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
   1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
      b. Class 150 and Class 300, Ductile-Iron or Steel, Raised-Face Flanges: Ring-type gaskets.
   2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

I. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Pressure Rating: 175-psig minimum.
   2. Galvanized Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
   3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Automatic (Ball Drip) Drain Valves:
   3. Type: Automatic draining, ball check.
   5. End Connections: Threaded.

2.4 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet 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. Anvil International, Inc.
      b. National Fittings, Inc.
      c. Shurjoint Piping Products.
      d. Tyco Fire & Building Products LP.
      e. Victaulic Company.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.
2. Standard: UL 199.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector’s Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.
5. Size: Same as connected piping.
7. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fivalco Inc.
   b. FlexHead Industries, Inc.
   c. Gateway Tubing, Inc.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
5. Size: Same as connected piping, for sprinkler.

2.5 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Reliable Automatic Sprinkler Co., Inc.
   3. Tyco Fire & Building Products LP.
   4. Victaulic Company.
   5. Viking Corporation.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:
   2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

E. Sprinkler Finishes: Chrome plated bronze and painted.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
   2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Reliable Automatic Sprinkler Co., Inc.
      b. Tyco Fire & Building Products LP.
      c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 199.

3. Type: Wire cage with fastening device for attaching to sprinkler.

2.6 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ADT Security Services, Inc.
      b. McDonnell & Miller; ITT Industries.
      c. Potter Electric Signal Company.
      d. System Sensor; a Honeywell company.
      e. Viking Corporation.
      f. Watts Industries (Canada) Inc.
   4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
   5. Type: Paddle operated.
   7. Design Installation: Horizontal or vertical.

C. Pressure Switches:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. System Sensor; a Honeywell company.
      c. Tyco Fire & Building Products LP.
      d. United Electric Controls Co.
      e. Viking Corporation.
   3. Type: Electrically supervised water-flow switch with retard feature.
   5. Design Operation: Rising pressure signals water flow.

D. Valve Supervisory Switches:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fire-Lite Alarms, Inc.; a Honeywell company.
      b. Kennedy Valve; a division of McWane, Inc.
      c. Potter Electric Signal Company.
      d. System Sensor; a Honeywell company.
   3. Type: Electrically supervised.
   5. Design: Signals that controlled valve is in other than fully open position.
   6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2.7 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AMETEK; U.S. Gauge Division.
   2. Ashcroft, Inc.
   4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0- to 250-psig minimum.

E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
   2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.
H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

M. Fill sprinkler system piping with water.

N. Install sleeves for piping penetrations of walls, ceilings, and floors.

O. Install sleeve seals for piping penetrations of concrete walls and slabs.

P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system’s pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Brazed Joints: Join copper tube and fittings according to CDA’s "Copper Tube Handbook," "Brazed Joints" Chapter.

O. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. Install valves in vertical position for proper direction of flow, in main supply to system.
   2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
   3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.
3.6 IDENTIFICATION
A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL
1. Leak Test: After installation, charge systems 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. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
C. Prepare test and inspection reports.

3.8 CLEANING
A. Clean dirt and debris from sprinklers.
B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.9 PIPING SCHEDULE
A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
B. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
   1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:
   1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3.10 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313
SECTION 220513
COMMON MOTOR REQUIREMENTS FOR PLUMBING 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, general-purpose, horizontal, small 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 NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS
   A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
   B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 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. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

C. Motors 1/20 HP and Smaller: Shaded-pole type.

D. 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 220513
SECTION 220517
SLEEVES AND SLEEVE SEALS 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. Sleeves.
   2. Sleeve-seal systems.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES
A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated. Provide with integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 SLEEVE-SEAL 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. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Plastic.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. It is this contractor’s responsibility to accurately set necessary sleeves for pipe before erection of structure. This Contractor is responsible for the correct size and location of all openings including coordination with the other trades.

C. Each sleeve shall be utilized for only one pipe. Block outs for multiple pipes or individual pipes are not allowed unless indicated on the Drawings or approved by the Architect.

D. On insulated systems install sleeves to allow for continuous insulation where sleeve-seals are not required.

E. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

F. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

G. Install sleeves for pipes passing through interior cast concrete or CMU partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

H. Fire-BARRIER Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials or approved firestop sleeve-seal. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

2. Exterior Concrete Walls below Grade:
   a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      2) Provide water stop.

3. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system or PVC-pipe sleeves
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves or PVC-pipe sleeves.

5. Interior Partitions:
   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves or PVC-pipe sleeves.
END OF SECTION 220517
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. Escutcheons.
   2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for 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.
   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, cast-brass type with polished, chrome-plated finish.
   g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
   i. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.

2. Escutcheons for Existing Piping:
   a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
   e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
   g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
   h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.
   i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.
   j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518
SECTION 220519
METERS AND GAGES 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. Light-activated thermometers.
   2. Thermowells.
   3. Dial-type pressure gages.
   4. Gage attachments.
   5. Test plugs.
   6. Test-plug kits.

B. Related Sections:
   1. Section 221113 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
   2. Section 221116 "Domestic Water Piping" for water meters inside the building.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:
   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. REOTEMP Instrument Corporation.
2. Case: Plastic; 9-inch nominal size unless otherwise indicated.
3. Scale(s): Deg F.
6. Stem: Aluminum and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
8. Accuracy: Plus or minus 2 deg F.

2.2 THERMOWELLS

A. Thermowells:
   2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
   3. Material for Use with Copper Tubing: CNR or CUNI.
   4. Material for Use with Steel Piping: CSA.
   5. Type: Stepped shank unless straight or tapered shank is indicated.
   6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
   7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
   8. Bore: Diameter required to match thermometer bulb or stem.
   9. Insertion Length: Length required to match thermometer bulb or stem.
   10. Lagging Extension: Include on thermowells for insulated piping and tubing.
   11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
   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. AMETEK, Inc.: U.S. Gauge.
      b. Ashcroft Inc.
      c. Marsh Bellofram.
      d. Noshok.
      e. Weiss Instruments, Inc.
      f. WIKA Instrument Corporation - USA.
      g. Winters Instruments - U.S.
   3. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
   4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

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. Flow Design, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.
D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids.

H. Install test plugs in piping tees.

I. Install thermometers as indicated on the drawings.
   1. Where thermometers are to be placed where a light activated thermometer receives no light such as behind an access panel, under counter, within a very dark mechanical room, provide a dial type thermometer.

J. Install pressure gages as indicated on the drawings.

K. Install test plugs in the following locations and where shown on the drawings:
   1. Inlet and outlet of each water heater.
   2. Inlet and outlet of each domestic hot-water storage tank.
   3. Suction and discharge of each domestic water pump.
   4. Inlet and outlet of each thermostatic mixing valve.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
   1. Direct-mounted, light-activated type.
   2. Test plug with EPDM self-sealing rubber inserts.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F.

B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.
3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be the following:
   1. Sealed, direct-mounted, metal case.
   2. Test plug with EPDM self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
   1. Sealed, direct-mounted, metal case.
   2. Test plug with EPDM self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
   1. Sealed, direct-mounted, metal case.
   2. Test plug with EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 200 psi.

B. Scale Range for Domestic Water Piping downstream of pressure-reducing valve: 0 to 100 psi.

C. Scale Range for Domestic Water Piping upstream of pressure-reducing valve: 0 to 200 psi.

END OF SECTION 220519
SECTION 220523.12
BALL 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 ball valves.
   2. Iron ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and soldered ends.

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.
   3. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.5 for flanges on steel valves.
   4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   6. ASME B31.9 for building services piping valves.


D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

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

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:
   1. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:
   1. Include 2-inch stem extensions.
   2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
   3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

A. Two-Piece, Bronze Ball Valves with Full Port, and Bronze or 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. 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:

b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: ASTM B61, B62 or B584 Bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.
j. All components shall be "Dezincification Resistant"
k. All components shall be certified "Lead Free"

2.3 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.

2. Description:

b. CWP Rating: 200 psig.
d. Body Material: ASTM A 126, gray iron.
e. Ends: Flanged or threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.
j. All components shall be certified "Lead-Free"

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 valve tags. Comply with requirements in Section 220533 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 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: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Two-piece, brass ball valves with full port and brass trim.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Class 150, iron ball valves.
PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Bronze swing check valves.
   2. Iron swing check valves.
   3. Iron, grooved-end swing check valves.

1.3 DEFINITIONS
A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene-diene terpolymer rubber.
C. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61 Annex G.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set 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. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B16.18 for solder joint.
   5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.


E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

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

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. 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.
   i. Zy-Tech Global Industries, Inc.

2. Description:
   a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.
g. All components shall be “Desincification Resistant”
h. All components shall be certified “Lead-Free”

2.3 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.
   l. 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.
   c. Body Design: Clear or full waterway.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged or threaded. See valve schedule articles.
   f. Trim: Bronze.
   g. Gasket: Asbestos free.
   h. All components shall be certified “Lead-Free”

2.4 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.
   c. Seal: EPDM.
   d. Disc: Spring operated, ductile iron or stainless steel.
   e. All components shall be certified “Lead-Free”

2.5 IRON, CENTER-GUIDED, SPRING-LOADED 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.
      l. Sure Flow Equipment Inc.
      m. Vales Strainers International; a division of CIRCOR International, Inc.
      n. Val-Matic Valve & Manufacturing Corp.
      o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   b. CWP Rating: 200 psig.
   d. Style: Compact wafer, spring loaded.
   e. Seat: Bronze.
   f. All components shall be certified “Lead-Free”

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 check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

G. When soldering use paste flux that are approved by the manufacturer for use with Lead Free Alloys.

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. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered.
   2. For Steel Piping, NPS 2 and Smaller: Threaded.
   3. For Grooved-End Copper Tubing and Steel Piping: Grooved.
3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze swing check valves, Class 125, bronze disc with soldered or threaded end connections.

END OF SECTION 220523.14
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:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield and shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Pipe positioning systems.
   8. Equipment supports.

B. Related Sections:
   1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS
A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS
A. 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.
   3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.
1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. 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.
B. Copper Pipe Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

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 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.**
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.


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.


7. Metallic Coating: Electroplated zinc Hot-dipped galvanized or equivalent.

2.4 THERMAL-HANGER SHIELD AND SHIELD INSERTS

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

1. Carpenter & Paterson, Inc.
3. ERICO International 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 or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig 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 ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig 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: Jacket and Vapor Barrier Extend 1 inches beyond sheet metal shield on each end for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Fastener Systems shall be one or both of the following as allowed by the structural drawings and specifications:

1. 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.
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-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.

2.6 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. Low-Type, Single-Pipe Stand: One-piece recycled rubber base unit with, for roof installation without membrane penetration.

C. 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: recycled rubber with load distribution plate.
   3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
   4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with pipe clamp-type pipe support.

D. 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: recycled rubber with load distribution plate.
   3. 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.

2.7 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.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 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.
2. Design Mix: 5000-psi, 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.

1. 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Fastener System Installation shall be one or both of the following as allowed by the structural engineer:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches 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.

E. Pipe Stand Installation:

1. Pipe Stand Types: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

F. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.
K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Support the system without sagging, including supports at each offset or change in pipe direction and at the ends of pipe branches over five feet in length.

M. Place a hanger within one foot of each horizontal elbow.

N. Install supports to provide a minimum ½ inch clear space between finished covering and adjacent work.

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. On all piping points of support install thermal-hanger shields and inserts with insulation insert the same thickness as adjoining pipe insulation.
   2. For piping operating below Ambient Air Temperature the vapor barrier jacket shall be sealed tight to adjoining insulation to provide a neat and complete vapor tight installation.
   3. Shield Dimensions for Pipe: Shall be as indicated by the manufacturer but not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 6 inches long and 0.048 inch thick.
      b. NPS 4: 6 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 6 inches long and 0.06 inch thick.
   4. When pipe hanger spacing exceeds 10 feet utilize a double layer thermal-hangar shield.
   5. For all piping with roller supports utilize a thermal-hangar shield with insert that includes a wear/weight distribution plate of carbon steel that has been primer painted.

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:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and 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.

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.

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 non-copper attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
F. Use copper-plated pipe hangers and copper or stainless-steel 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.
2. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
4. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

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.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 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:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F 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. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
5. C-Clamps (MSS Type 23): For structural shapes.
6. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
7. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
8. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
9. Wall Supports: NPS 1/2 through 3: Offset or straight steel hook
    a. NPS 4 and above: Welded steel bracket or metal framing system with hangars and supports as noted elsewhere.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

O. 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:
   1. Equipment labels.
   2. Pipe labels.
   3. Valve tags.

1.3 ACTION SUBMITTALS

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

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
   2. Letter Color: Black.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters 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), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS
A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. 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; also include 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 and any special instructions noted in Part 3 of this specification.
   2. Lettering Size: At least 1-1/2 inch.

2.3 VALVE TAGS
A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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.

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 GENERAL INSTALLATION REQUIREMENTS

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.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe Label Locations: 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 30 feet along each run. Reduce intervals to 20 feet in areas of congested piping and equipment.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:

1. Domestic Water Piping
   a. Background: Safety green.

2. Sanitary Waste Piping:

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, faucets, convenience hose connections 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:

2. Valve-Tag Colors:
   b. Hot Water: Natural.

3. Letter Colors:

END OF SECTION 220553
SECTION 220719
PLUMBING PIPING 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 insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing 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 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.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

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 sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping 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 “Piping Insulation Schedule, General,” “Indoor Piping Insulation Schedule,” “Outdoor, Aboveground Piping Insulation Schedule,” and “Outdoor, Underground Piping Insulation 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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Aeroflex USA, Inc.; Aerocel.
   b. Armacell LLC; AP Armachex.
   c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

F. Mineral-Fiber, Preformed Pipe Insulation:
1. **Products**: Subject to compliance with requirements, provide one of the following:

   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Johns Manville; Micro-Lok.
   c. Knauf Insulation; 1000-Degree Pipe Insulation.
   d. Manson Insulation Inc.; Alley-K.
   e. Owens Corning; Fiberglas Pipe Insulation.

2. **Type I, 850 Deg F Materials**
   
   Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in “Factory-Applied Jackets” Article.

### 2.2 INSULATING CEMENTS

A. **Mineral-Fiber Insulating Cement**: Comply with ASTM C 195.

### 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. **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 LLC; Armoflex 520 Adhesive.
      d. K-Flex USA; R-373 Contact Adhesive.

   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. **Mineral-Fiber Adhesive**: Comply with MIL-A-3316C, Class 2, Grade A.

   1. **Products**: Subject to compliance with requirements, provide one of the following:

      b. Eagle Bridges - Marathon Industries; 225.
      d. Mon-Eco Industries, Inc.; 22-25.

   2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. **ASJ Adhesive, and FSK Jacket Adhesive**: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

   1. **Products**: Subject to compliance with requirements, provide one of the following:
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 739, Dow Silicone.
   d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have 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-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 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 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:
   b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.


2.5 SEALANTS

A. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.

5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Zeston.
   c. Proto Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color-code jackets based on system.
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.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.9 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. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.

2.10 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Engineered Brass Company.
b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
c. McGuire Manufacturing.
d. Plumberex.
e. Truebro; a brand of IPS Corporation.
f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. 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 thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. 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 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 piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.

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 below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistant 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 Section 078413 "Penetration Firestopping."
3.5 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. 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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.
   3. 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.
   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.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. 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.

3.9 FINISHES

A. Piping exposed in mechanical rooms (i.e. fan rooms, boiler room, chiller room, etc…) that is not required to have a PVC jacket shall have the insulation ASJ or other Paintable Jacket material painted to match Color Coding by system type.

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.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.10 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.
3.11 INDOOR PIPING INSULATION SCHEDULE

A. All piping insulation shall comply with the type and insulation thickness noted in the schedule below and as noted elsewhere.

<table>
<thead>
<tr>
<th>Piping System Types</th>
<th>Insulation Type</th>
<th>Fluid Temperature Range</th>
<th>&lt; 1&quot;</th>
<th>1&quot; to 1-1/4&quot;</th>
<th>1-1/2&quot; to 3&quot;</th>
<th>4&quot; to 6&quot;</th>
<th>8&quot; and larger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Cold Water</td>
<td>Flexible Elastomeric or Mineral-Fiber Preformed Pipe Insulation w/Wicking System</td>
<td>35 to 65 Deg F</td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
</tr>
<tr>
<td>Domestic Hot Water</td>
<td>Flexible Elastomeric or Mineral-Fiber Preformed Pipe Insulation</td>
<td>105 to 160 Deg F</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1-1/2&quot;</td>
<td>1-1/2&quot;</td>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>Storm Water and Overflow</td>
<td>Flexible Elastomeric or Mineral-Fiber Preformed Pipe Insulation w/Wicking System</td>
<td>35 to 65 Deg F</td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
</tr>
<tr>
<td>Condensate and Equipment Drain Water</td>
<td>Flexible Elastomeric or Mineral-Fiber Preformed Pipe Insulation</td>
<td>&lt; 60 Deg F</td>
<td>1/2&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1&quot;</td>
<td>1-1/2&quot;</td>
</tr>
</tbody>
</table>

Notes: 1 - For piping exposed to the outside ambient conditions, increase thickness of insulation by 1/2".

B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures:

1. Provide protection shielding guard.
3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   1. None.

D. Piping, Exposed:
   1. General Areas: PVC, color shall be as selected by Architect.
   2. Mechanical Rooms (i.e. fan rooms, boiler rooms, etc): PVC color coated by system: 30 mils thick.

END OF SECTION 220719
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, and fittings inside buildings.
   2. Encasement for piping.

1.3 ACTION SUBMITTALS
A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS
A. System purging and disinfecting activities report.
B. Field quality-control reports.

1.5 FIELD CONDITIONS
A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions:
   1. Notify Architect no fewer than two days in advance of proposed interruption of water service.
   2. Do not interrupt water service without Architect's written permission.

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.
B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with “NSF-pw.”

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.


D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions:
   1. MSS SP-123.
   4. Solder-joint or threaded ends.

F. Copper Pressure-Seal-Joint Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkhart Products Corporation.
      b. NIBCO Inc.
      c. Viega.
   2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
   3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

G. Copper-Tube, Extruded-Tee Connections:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. T-Drill Industries Inc.
   2. Description: Tee formed in copper tube according to ASTM F 2014.

H. Appurtenances for Grooved-End Copper Tubing:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International.
      b. Shurjoint Piping Products.
      c. Victaulic Company.
   2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
   3. Mechanical Couplings for Grooved-End Copper Tubing:
      a. Copper-tube dimensions and design similar to AWWA C606.
b. Ferrous housing sections.
c. EPDM-rubber gaskets suitable for hot and cold water.
d. Bolts and nuts.
e. Minimum Pressure Rating: 300 psig.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Push-on-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51.
2. Pipe shall conform to AWWA C104 when required by the water utility.
3. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

B. Appurtenances for Grooved-End, Ductile-Iron Pipe:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Shurjoint Piping Products.
   b. Star Pipe Products.
   c. Victaulic Company.
2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.
3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
   a. AWWA C606 for ductile-iron-pipe dimensions.
   b. Ferrous housing sections.
   c. EPDM-rubber gaskets suitable for hot and cold water.
   d. Bolts and nuts.
   e. Minimum Pressure Rating:
      1) NPS 4 to NPS 18: 250 psig.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. 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.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.
B. Form: tube.
C. Color: Black or natural.

2.6 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.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Nipples and couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elster Perfection Corporation.
      b. Grinnell Mechanical Products; Tyco Fire Products LP.
      c. Matco-Norca.
      d. Precision Plumbing Products, Inc.
      e. Victaulic Company.
   3. Electroplated steel nipple complying with ASTM F 1545.
   4. Pressure Rating and Temperature: 300 psig at 225 deg F.
   5. End Connections: Male threaded or grooved.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "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/A21.5.

E. Install domestic water piping level without pitch and plumb.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. 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.

H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

I. Install piping to permit valve servicing.

J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

N. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

O. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 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 for Copper Tubing: Comply with CDA’s "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: 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 for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. 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.

H. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

I. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

J. 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.

K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
3.6 **Hanger and Support Installation**

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

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.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.
   5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
   6. NPS 6: 10 feet with 5/8-inch rod.
   7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 **Connections**

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for 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 that required by plumbing code.
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 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 “Identification for Plumbing Piping and Equipment.”

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:
   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. 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:
      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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
   c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:
   a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   b. 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.
   c. 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.
   d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. 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 hot-water flow 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.
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.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:

      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Repeat procedures if biological examination shows contamination.
   e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
3.12 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. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.13 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 valves for piping NPS 2 and smaller. Use butterfly, ball, valves with flanged ends for piping NPS 2-1/2 and larger.
   2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

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.

END OF SECTION 221116
SECTION 221316
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:
1. Section 226600 "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:


1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

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 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class(es).
B. Gaskets: ASTM C 564, rubber.
C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ANACO-Husky.
   c. Fernco Inc.
   d. Matco-Norca, Inc.
   e. MIFAB, Inc.
   f. Mission Rubber Company; a division of MCP Industries, Inc.
   g. Stant.
   h. Tyler Pipe.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.
   1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Solvent Cement: ASTM D 2564.
   1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

B. Dielectric Fittings:
   1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
   2. Dielectric Nipples:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Elster Perfection.
         2) Grinnell Mechanical Products.
         3) Matco-Norca, Inc.
         4) Precision Plumbing Products, Inc.
         5) Victaulic Company.
      b. Description:
         1) Standard: IAPMO PS 66
         2) Electroplated steel nipple.
         3) Pressure Rating: 300 psig at 225 deg F.
         4) End Connections: Male threaded or grooved.
         5) Lining: Inert and noncorrosive, propylene.
PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. 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.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. 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 two 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.

I. 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.

J. Drain lines shall not be less than 2 inches when located below slab on grade floor.

K. Exterior vent terminations shall be increased to a minimum of 3 inches 1 foot below the roof or inside of the wall prior to the termination for frost protection. Roof vent terminations shall be atleast 2 feet from the roof edge, parapet or wall line.

L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Drain: 2 percent (1/4" per foot) downward in direction of flow for piping NPS 3 and smaller; 1 percent (1/8" per foot) downward in direction of flow for piping NPS 4 and larger.

2. Vent Piping: 1 percent (1/8" per foot) down toward vertical fixture vent or toward vent stack.

M. 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/A 21.5.

N. Install steel piping according to applicable plumbing code.

O. Install underground PVC piping according to ASTM D 2321.

P. Install engineered soil and waste drainage and vent piping systems as follows:


Q. Plumbing Specialties:

1. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION


B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

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 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.
D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

E. Plastic, Nonpressure-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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD’s.
4. In Underground Force Main Piping:
   a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
   b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.
B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install supports for vertical steel piping every 15 feet.

H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.

I. Install supports for vertical PVC piping every 48 inches.

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 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. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. 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 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
3.8 **IDENTIFICATION**

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 **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. 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. 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.

3.10 **CLEANING AND PROTECTION**

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.
3.11  PIPING SCHEDULE

A.  Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B.  Aboveground, soil and waste piping NPS 4 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; CISPI hubless-piping couplings; and coupled joints.

C.  Aboveground, vent piping NPS 4 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; CISPI hubless-piping couplings; and coupled joints.
   3.  Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D.  Underground, soil, waste, and vent piping NPS 4 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; CISPI cast-iron hubless-piping couplings; and coupled joints.
   3.  Solid wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.

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. Section Includes:
      1. Cleanouts.
      2. Floor drains.
      3. Roof flashing assemblies.
      5. Flashing materials.
   B. Related Requirements:

1.3 DEFINITIONS
   A. HDPE: High-density polyethylene plastic.
   B. PE: Polyethylene plastic.
   C. PP: Polypropylene plastic.
   D. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated. Include rated capacities, operating
      characteristics, and accessories:

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For drainage piping specialties to include in emergency,
      operation, and maintenance manuals.

1.6 QUALITY ASSURANCE
   A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing
      agency.

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 Section 033000 "Cast-in-Place Concrete."

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Metal Floor Cleanouts:
   1. ASME A112.36.2M, Cast-Iron Cleanouts:
      b. Oatey.
      c. Sioux Chief Manufacturing Company, 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 threaded, adjustable housing cleanout.
   3. Size: Same as connected branch.
   4. Type: Threaded, adjustable housing.
   5. Body or Ferrule: Cast iron.
   7. Outlet Connection: Same as connected branch.
   8. Closure: Brass plug with straight threads and gasket.
   9. Adjustable Housing Material: Cast iron with threads.
  11. Frame and Cover Shape: Round or Square.
  12. Top Loading Classification: Medium Duty.
  13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
  15. Size: Same as connected branch.
  17. Closure: Stainless steel with seal.
  18. Riser: Stainless-steel drainage pipe fitting to cleanout.

B. Cast-Iron or exposed Wall Cleanouts:
   b. MIFAB, Inc.
   c. Sioux Chief Manufacturing Company, Inc.
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** or **Hubless, cast-iron soil pipe test tee** as required to match connected piping.
5. Closure: **Countersunk or raised-head, drilled-and-threaded brass** plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, **flat, chrome-plated brass or stainless-steel** cover plate with screw.

### 2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains and equipment room drains:
   b. MIFAB, Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products Inc.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3
3. Pattern: **Floor drain**.
5. Seepage Flange: As required by adjacent surfaces.
6. Anchor Flange: As required by adjacent surfaces.
7. Clamping Device: As required by adjacent surfaces.
8. Outlet: **Bottom** or side as indicated on drawings.
9. Top or Strainer Material: Heel Proof **Nickel bronze**.
10. Top Shape: **Square or round as indicated on drawings**.
11. Top Loading Classification: **Medium Duty**.
12. Funnel: **Required** where indicated on plans.
13. Trap Pattern: **Deep-seal P-trap**.

### 2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
   a. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.
2. Description: Manufactured assembly made of **4.0-lb/sq. ft., 0.0625-inch-thick**, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
   b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
   c. Extended Vent Cap: With field-installed, vandal-proof vent cap.
2.4 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., 0.0625-inch thickness.
   2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch 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.
   2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.


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.

2.5 SOLIDS INTERCEPTORS

A. Solids Interceptors
   1. Plastic Solids Interceptors:
   2. See drawings for requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.
B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. 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 or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch 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.

D. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

E. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

F. Install through-penetration firestop assemblies in plastic at floor penetrations.

G. Install deep-seal traps on floor drains and other waste outlets, if indicated.

H. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

I. Install wood-blocking reinforcement for wall-mounting-type specialties.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

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., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch 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, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches 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 Section 076200 “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 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 226600
CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

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:

1.3 DEFINITIONS
A. CR: Chlorosulfonated polyethylene synthetic rubber.
B. FPM: Vinlylidene fluoride-hexafluoro propylene copolymer rubber.

1.4 PERFORMANCE REQUIREMENTS
A. Single-Wall Piping Pressure Rating: 10 feet head of water.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

1.6 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For chemical-waste specialties and to include in emergency, operation, and maintenance manuals.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.
B. Do not store plastic pipe or fittings in direct sunlight.
C. Protect pipe, fittings, and seals from dirt and damage.
1.8 PROJECT CONDITIONS

A. Interruption of Existing Chemical-Waste Service: Do not interrupt chemical-waste service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary chemical-waste service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of chemical-waste service.
2. Do not proceed with interruption of chemical-waste service without Architect's written permission.

PART 2 - PRODUCTS

2.1 SINGLE-WALL PIPE AND FITTINGS

A. PE Drainage Pipe and Fittings: Made of ASTM D 4976, PE resin.

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. ISCO Industries, LLC.
   b. Performance Pipe; a division of Chevron Phillips Chemical Company LLC.


B. PP Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101; with fusion- and mechanical-joint ends.

1. Exception: Pipe and fittings made from PP resin without fire-retardant additive may be used for underground installation.
2. 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. IPEX Inc.
   b. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
   c. Sloane, George Fischer Inc.
   d. Town & Country Plastics, Inc.
   e. Watts Industries (Canada) Inc.
   f. Zurn Plumbing Products Group; Chemical Drainage Systems.

C. PVC Drainage Pipe and Fittings: ASTM D 2665, pipe and drainage-pattern 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. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
   b. Watts Industries (Canada) Inc.
   c. Zurn Plumbing Products Group; Chemical Drainage Systems.

E. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, and gaskets; compatible with piping and system liquid; made for joining different piping materials.

### 2.2 JOINING MATERIALS

A. Couplings: Assemblies with combination of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.

B. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.

C. Flanges: Assemblies of companion flanges and gaskets complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.

D. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
   1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall have 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 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

#### 3.2 PIPING INSTALLATION

A. Chemical-Waste Piping Inside the Building:
   1. Install piping next to equipment, accessories, and specialties to allow service and maintenance.
   2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
   3. Flanges may be used on aboveground piping unless otherwise indicated.
   4. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
5. 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.
6. Install piping at indicated slopes.
7. Install piping free of sags and bends.
8. Install fittings for changes in direction and branch connections.
9. Verify final equipment locations for roughing-in.
10. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
11. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
12. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Chemical-Waste Piping Inside the Building:
   1. Plastic-Piping Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.
   2. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.
   5. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 HANGER AND SUPPORT INSTALLATION

A. Pipe sizes in this article refer to aboveground, single-wall piping.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
   1. Vertical Piping: MSS Type 8 or MSS Type 42, riser clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls.
      Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for installation of supports.

D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
E. Support vertical piping and tubing at base and at each floor.

F. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of 3/8 inch.

G. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 33 inches with 3/8-inch rod.
2. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8: 48 inches with 7/8-inch rod.

H. Install supports for vertical PP piping every 72 inches.

I. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 36 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 42 inches with 3/8-inch rod.
3. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.

J. Install supports for vertical PVC piping every 48 inches.

K. Install vinyl-coated hangers for PVDF piping with the following maximum horizontal spacing and minimum rod diameters:

1. All Sizes: Install continuous support for piping with liquid waste at temperatures above 140 deg F.
2. NPS 1/2 and Smaller: 30 inches with 3/8-inch rod.
3. NPS 3/4 to NPS 1-1/2: 36 inches with 3/8-inch rod.
4. NPS 2: 36 inches with 3/8-inch rod.
5. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.

L. Install supports for vertical PVDF piping NPS 1-1/2 every 48 inches and NPS 2 and larger every 72 inches.

M. Support piping and tubing not listed above according to MSS SP-69.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make connections to existing piping so finished Work complies as nearly as practical with requirements specified for new Work.

C. Use commercially manufactured wye fittings for sewerage piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

D. Protect existing piping to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.
E. Install piping adjacent to equipment to allow service and maintenance.

3.6 LABELING AND IDENTIFICATION

A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for labeling of equipment and piping.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.7 FIELD QUALITY CONTROL

A. Inspect interior of sewerage piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place and again at completion of Project.

1. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between inspection points.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Air Tests for Drainage Piping: Comply with UNI-B-6.

2. Leaks and loss in test pressure constitute defects that must be repaired.
3. Submit separate reports for each test.

B. Replace leaking sewerage piping using new materials, and repeat testing until leakage is within allowances specified.

C. Perform tests and inspections.

D. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

E. Chemical-waste piping will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 CLEANING

A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Clean piping by flushing with potable water.
3.9 **PIPING SCHEDULE**

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below unless otherwise indicated.

B. Single-Wall, Chemical-Waste Sewerage Piping: Use any of the following piping materials for each size range:
1. NPS 1-1/2 to NPS 4: PE drainage pipe and fittings and heat-fusion joints.
2. NPS 1-1/2 to NPS 4: PP drainage pipe and fittings and electrofusion joints.
3. NPS 1-1/2 to NPS 4: PVC drainage pipe and fittings and solvent-cemented joints.
4. NPS 1-1/2 to NPS 4: PVDF drainage pipe and fittings and electrofusion joints.

C. Aboveground Chemical-Waste Piping: Use any of the following piping materials for each size range:
1. NPS 1-1/2 to NPS 6: PP drainage piping and mechanical joints.
2. NPS 1-1/2 to NPS 6: PVC drainage piping and solvent-cemented joints.
3. NPS 1-1/2 to NPS 6: PVDF drainage piping and mechanical joints.
4. NPS 1-1/2 to NPS 6: NPS 2 to NPS 6 high-silicon-iron piping with hub-and-plain ends and caked joints.

D. Under Slab-on-Grade, Indoor, Chemical-Waste Piping: Use any of the following piping materials for each size range:
1. NPS 1-1/2 to NPS 6: PP drainage piping and electrofusion joints.
2. NPS 1-1/2 to NPS 6: PVC drainage piping and solvent-cemented joints.
3. NPS 1-1/2 to NPS 6: PVDF drainage piping and electrofusion joints.
4. NPS 10 and NPS 12: PVC drainage piping and solvent-cemented joints.
5. NPS 10 to NPS 15: High-silicon-iron piping with hub-and-plain ends and caked joints.

END OF SECTION 226600
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 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 NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS
A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 6000 feet above sea level.

   B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
2.3 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 230517
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated. Provide with integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 SLEEVE-SEAL 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. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Plastic.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. It is this contractor’s responsibility to accurately set necessary sleeves for pipe before erection of structure. This Contractor is responsible for the correct size and location of all openings including coordination with the other trades.

C. Each sleeve shall be utilized for only one pipe. Block outs for multiple pipes or individual pipes are not allowed unless indicated on the Drawings or approved by the Architect.

D. On insulated systems install sleeves to allow for continuous insulation where sleeve-seals are not required.

E. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.

F. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

G. Install sleeves for pipes passing through interior cast concrete or CMU partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
H. Fire-BARRIER Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials or approved firestop sleeve-seal. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

2. Exterior Concrete Walls below Grade:
   a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

   1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

   2) Provide water stop.

3. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

   1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

5. Interior Partitions:

END OF SECTION 230517
SECTION 230518
ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
1. Escutcheons.
2. Floor plates.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS
A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES
A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for 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.
   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, cast-brass type with polished, chrome-plated finish.
   f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
   g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
   h. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with exposed-rivet hinge.

2. Escutcheons for Existing Piping:
   a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   e. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
   f. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518
SECTION 230519

METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Light-activated thermometers.
   2. Thermowells.
   3. Dial-type pressure gages.
   4. Gage attachments.
   5. Test plugs.

B. Related Sections:

1.3 ACTION SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:

   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. REOTEMP Instrument Corporation.
      c. Trerice, H. O. Co.
      d. Weiss Instruments, Inc.
2.2 THERMOWELLS

A. Thermowells:

2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

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. AMETEK, Inc.; U.S. Gauge.
   b. Ashcroft Inc.
   c. Marsh Bellofram.
   d. Noshok.
   e. Weiss Instruments, Inc.
   f. WIKA Instrument Corporation - USA.
   g. Winters Instruments - U.S.

3. Case: Liquid-filled or Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

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. Flow Design, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.
E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids (except steam).

H. Install test plugs in piping tees.

I. Install permanent indicators on walls or brackets in accessible and readable positions.

J. Install connection fittings in accessible locations for attachment to portable indicators.

K. Install thermometers where shown on drawings:

L. Install pressure gages where shown on drawings:

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer’s written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Condenser-Water Piping: 0 to 100 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at inlet and outlet of each condenser-water connection shall be the following:

1. Liquid-filled, direct-mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Condenser-Water Piping: 0 to 100 psi.

END OF SECTION 230519
SECTION 230523.12
BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Bronze ball valves.
   2. Steel ball valves.
   3. Iron ball valves.

1.3 DEFINITIONS
A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and weld ends.
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 operating handles or stems as lifting or rigging points.
PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded-end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.5 for flanges on steel valves.

C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

D. Refer to HVAC valve schedule articles for applications of valves.

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

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:
   1. Handlever: For quarter-turn valves smaller than NPS 6.

H. Valves in Insulated Piping:
   1. Include 2-inch stem extensions.
   2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
   3. Memory stops that are fully adjustable after insulation is applied.

I. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece Bronze Ball Valves with Full Port and Bronze or 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. 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.
2. Description:

b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

### 2.3 STEEL BALL VALVES

A. Class 150 Steel Ball Valves with Full Port and Stainless-Steel Trim:

1. Description:

   d. Body Material: Carbon steel, ASTM A 216, Type WCB.
   e. Ends: Flanged.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Full.

### 2.4 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.

2. Description:

   b. CWP Rating: 200 psig.
   d. Body Material: ASTM A 126, gray iron.
   e. Ends: Flanged.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel.
   i. Port: Full.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 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: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
5. For Steel Piping, NPS 5 and Larger: Flanged ends.
3.4 CONDENSER-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Two piece, full port, bronze with brass or bronze trim.
   1. Valves may be provided with solder-joint ends instead of threaded ends.

B. Pipe NPS 2-1/2 and Larger:
   1. Iron ball valves.
      a. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
   2. Class 150 steel ball valves.

END OF SECTION 230523.12
SECTION 230523.14
CHECK VALVES FOR HVAC PIPING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Bronze swing check valves.
   2. Iron swing check valves.
   3. Iron, grooved-end swing check valves.

1.3 DEFINITIONS
A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. 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. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded-end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B16.18 for solder joint.
   5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

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

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. 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.
      i. Zy-Tech Global Industries, Inc.
   2. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 300 psig.
      c. Body Design: Horizontal flow.
      e. Ends: Threaded.
      f. Disc: Bronze.
2.3  **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.
   l. 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. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   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.

2.4  **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. Grinnell Mechanical Products.
   d. Victaulic Company.

2. Description:

   a. CWP Rating: 300 psig.
   c. Seal: EPDM.
   d. Disc: Spring operated, ductile iron or stainless steel.
2.5 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.
   l. Spence Strainers International; a division of CIRCOR International.
   m. Sure Flow Equipment Inc.
   n. Val-Matic Valve & Manufacturing Corp.
   o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Material: ASTM A 126, gray iron.
   e. Style: Compact wafer.
   f. Seat: Bronze.

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 check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.

F. Install valve tags. Comply with requirements for valve tags and schedules in Section 230553 "Identification for HVAC Piping and Equipment."

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. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.

B. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
   3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
   5. For Steel Piping, NPS 5 and Larger: Flanged ends.
   6. For Grooved-End Steel Piping Valve ends may be grooved.

3.5 **CONDENSER-WATER VALVE SCHEDULE**

A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Swing Check Valves: Class 125, metal seats.
3. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
4. Iron, Center-Guided Check Valves, NPS 2-1/2 to NPS 24: Class 125, metal seat.

END OF SECTION 230523.14
SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Metal pipe hangers and supports.
      2. Trapeze pipe hangers.
      3. Metal framing systems.
      4. Thermal-hanger shield and shield inserts.
      5. Fastener systems.
      6. Pipe stands.
      7. Equipment supports.

   B. Related Sections:
      1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
      2. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
      3. Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts" for duct hangers and supports.

1.3 DEFINITIONS
   A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS
   A. Structural Performance: Hangers and supports for HVAC 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.
      3. Design seismic-restraint hangers and supports for piping and equipment.
1.5 **ACTION SUBMITTALS**

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

1.6 **INFORMATIONAL SUBMITTALS**

A. Welding certificates.

1.7 **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.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

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 **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.


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.


7. Metallic Coating: Electroplated zinc or Hot-dipped galvanized or equivalent

### 2.4 THERMAL-HANGER SHIELD AND SHEILD INSERTS

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

1. Carpenter & Paterson, Inc.
3. ERICO International 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 or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig 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 ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. Jacket or Vapor Barrier: Shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84.

E. Shield: Provide a minimum G-90 galvanized steel thermal-hanger shield for all shield inserts.

F. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

G. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

H. Insert, Jacket and Vapor Barrier Length: Extend 1 inche beyond sheet metal shield on each end for piping operating below ambient air temperature.
2.5 FASTENER SYSTEMS

A. Fastener Systems shall be one or both of the following as allowed by the structural drawings and specifications:

1. 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.
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-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.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 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.

2. Design Mix: 5000-psi, 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.

1. 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
D. Fastener System Installation shall be a one or both of the following as allowed by the structural drawings and specifications:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches 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.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Where applicable install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts. Where concrete slabs form finished ceiling, finish inserts flush with slab surface. For existing or precast concrete slabs attachments shall be made using concrete anchors.

J. Install additional supports at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.

K. Support the system without sagging, including supports at each offset or change in pipe direction and at the ends of pipe branches over five feet in length.

L. Place a hanger within one foot of each horizontal elbow.

M. Install supports to provide a minimum ½ inch clear space between finished covering and adjacent work.

N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. 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.

P. Insulated Piping:

1. On all piping points of support install thermal-hanger shields and inserts with insulation insert the same thickness as adjoining pipe insulation.

2. For piping operating below Ambient Air Temperature the vapor barrier jacket shall be sealed tight to adjoining insulation to provide a neat and complete vapor tight installation.
3. Shield Dimensions for Pipe: Shall be as indicated by the manufacturer but not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 6 inches long and 0.048 inch thick.
   b. NPS 4: 6 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 6 inches long and 0.06 inch thick.

4. When pipe hanger spacing exceeds 10 feet utilize a double layer thermal-hangar shield.

5. For all piping with roller supports utilize a thermal-hangar shield with insert that includes a wear/weight distribution plate of carbon steel that has been primer painted.

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:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and 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.
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.

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 non-copper attachments are in direct contact with copper tubing.
E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers metal framing systems and attachments for general service applications.
F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
G. Use padded hangers for piping that is subject to scratching.
H. Use thermal-hanger shields and 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.
   2. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   4. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 6 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
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.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 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:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.  
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.  
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.  
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F 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. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.  
4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.  
5. C-Clamps (MSS Type 23): For structural shapes.  
6. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.  
   b. Medium (MSS Type 32): 1500 lb.  
   c. Heavy (MSS Type 33): 3000 lb.

7. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.  
8. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.  
9. Wall Supports:
   a. NPS 1/2 through 3: Offset or straight steel hook  
   b. NPS 4 and above: Welded steel bracket or metal framing system with hangars and supports as noted elsewhere.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.  
N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.  
O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.  
P. END OF SECTION 230529
SECTION 230548.13
VIBRATION CONTROLS 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:
   1. Elastomeric isolation pads.
   2. Resilient pipe guides.
   3. Elastomeric hangers.
   4. Spring hangers.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

1.4 QUALITY ASSURANCE
A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS
A. Elastomeric Isolation Pads:
   1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
   2. Size: Factory or field cut to match requirements of supported equipment.
   3. Pad Material: Oil and water resistant with elastomeric properties.
   4. Surface Pattern: Ribbed pattern.
   5. Infused nonwoven cotton or synthetic fibers.
2.2 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
   1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.3 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
   1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.4 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside 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. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points.

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 230548.13
SECTION 230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

2. Letter Color: Black.


4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters 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), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

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; also include 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 1/2 inch high.

2.3 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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.

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 GENERAL INSTALLATION REQUIREMENTS

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.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe Label Locations: 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 and on both sides of 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 30 feet along each run. Reduce intervals to 20 feet in areas of congested piping and equipment.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:

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:
END OF SECTION 230553
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. Balancing Air Systems:
   a. Constant-volume air systems.

2. Balancing Hydronic Piping Systems:
   a. Variable-flow hydronic systems.

3. Testing, Adjusting, and Balancing Equipment:
   a. Motors.

4. Testing, adjusting, and balancing existing systems and equipment.
5. Duct leakage tests.
6. Control system verification.

1.3 DEFINITIONS

B. BAS: Building automation systems.
D. TAB: Testing, adjusting, and balancing.
F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
G. TDH: Total dynamic head.
1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

C. Certified TAB reports.

D. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC NEBB or TABB.
   1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC NEBB or TABB.
   2. TAB Technician: Employee of the TAB specialist and certified by AABC NEBB or TABB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

1.6 FIELD 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.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, available TAB specialists that may be engaged include, but are not limited to, the following:
   1. Finn and Associates
2. Jedi Balancing
3. Elite Balancing

3.2 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 installed systems for 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 applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine equipment to ensure it is in a safe and normal operable condition.

E. Examine ceiling plenums and underfloor air plenums 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/or Nonmetal Ducts” and are properly separated from adjacent areas. Verify that the supply, return and exhaust ducts are installed and tested to the leakage class specified in Division 23 Section “Metal Ducts and/or Nonmetal Ducts.” Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as heat pumps, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

K. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.
O. 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. Make special note of any discrepancy between tabulated conditions and specified conditions including but not limited to: missing items, non-functioning items, items without final connections, etc… Call these discrepancies to the attention of the Architect.

3.3 PREPARATION

A. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
   a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
   b. Duct systems are complete with terminals installed.
   c. Volume, smoke, and fire dampers are open and functional.
   d. Clean filters are installed.
   e. Fans are operating, free of vibration, and rotating in correct direction.
   f. Automatic temperature-control systems are operational.
   g. Ceilings are installed.
   h. Windows and doors are installed.
   i. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
   a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
   b. Piping is complete with terminals installed.
   c. Water treatment is complete.
   d. Systems are flushed, filled, and air purged.
   e. Strainers are pulled and cleaned.
   f. Control valves are functioning per the sequence of operation.
   g. Shutoff and balance valves have been verified to be 100 percent open.
   h. Pumps are started and proper rotation is verified.
   i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   j. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 SMACNA’s “HVAC Systems - Testing, Adjusting, and Balancing” and in this Section.

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, install test ports and duct access doors that comply with requirements in Section 233300 “Air Duct Accessories.”
   2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 “Duct 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. Set and lock all memory stops.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

C. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

D. Verify that motor starters are equipped with properly sized thermal protection.

E. Check dampers for proper position to achieve desired airflow path.

F. Check for airflow blockages.

G. Check condensate drains for proper connections and functioning.

H. Check for proper sealing of air-handling-unit components.

I. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

   a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.

   b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

   c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

   d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

   a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report artificial loading of filters at the time static pressures are measured.

3. 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 occurs. 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.
1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performation data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.
3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:
   1. Verify that the differential-pressure sensor is located as indicated.
   2. Determine whether there is diversity in the system.

C. For systems with no diversity:
   1. Adjust pumps to deliver total design gpm.
      a. Measure total water flow.
         1) Position valves for full flow through coils.
         2) Measure flow by main flow meter, if installed.
         3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
      
      b. Measure pump TDH as follows:
         1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
         2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
         3) Convert pressure to head and correct for differences in gage heights.
         4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
         5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.


   2. Adjust flow-measuring devices installed in mains and branches to design water flows.
      a. Measure flow in main and branch pipes.
      b. Adjust main and branch balance valves for design flow.
      c. Re-measure each main and branch after all have been adjusted.

   3. Adjust flow-measuring devices installed at terminals for each space to design water flows.
      a. Measure flow at terminals.
      b. Adjust each terminal to design flow.
      c. Re-measure each terminal after it is adjusted.
      d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
      e. Perform temperature tests after flows have been balanced.
4. For systems without pressure-independent valves or flow-measuring devices at terminals:
   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

5. Prior to verifying final system conditions, determine the system differential-pressure set point.

6. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

7. Mark final settings and verify that all memory stops have been set.

8. Verify final system conditions as follows:
   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   c. Mark final settings.

9. Verify that memory stops have been set.

D. For systems with diversity:

1. Determine diversity factor.
2. Adjust pumps to deliver total design gpm.
   a. Measure total water flow.
      1) Position valves for full flow through coils.
      2) Measure flow by main flow meter, if installed.
      3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
   b. Measure pump TDH as follows:
      1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      3) Convert pressure to head and correct for differences in gage heights.
      4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
      5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Adjust flow-measuring devices installed in mains and branches to design water flows.
   a. Measure flow in main and branch pipes.
   b. Adjust main and branch balance valves for design flow.
   c. Re-measure each main and branch after all have been adjusted.
4. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
   e. Perform temperature tests after flows have been balanced.

5. For systems with pressure-independent valves at terminals:
   a. Measure differential pressure, and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.

6. For systems without pressure-independent valves or flow-measuring devices at terminals:
   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

7. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.

8. Prior to verifying final system conditions, determine system differential-pressure set point.

9. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

10. Mark final settings and verify that memory stops have been set.

11. Verify final system conditions as follows:
   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   c. Mark final settings.

12. Verify that memory stops have been set.

### 3.9 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.
   4. Phase and hertz.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter size and thermal-protection-element rating.
   8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.
3.10 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

3.11 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.12 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.
4. Check the condition of coils.
5. Check the operation of the drain pan and condensate-drain trap.
6. Check bearings and other lubricated parts for proper lubrication.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.13 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent to minus 5 percent.
2. Air Outlets and Inlets: Plus 10 percent to minus 5 percent.
3. Water Flow Rate: Plus 10 percent to minus 5 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.14 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.
3. Certify validity and accuracy of field data.

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 specialist.
3. Project name.
4. Project location.
5. Architect’s name and address.
6. Engineer’s name and address.
7. Contractor’s name and address.
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. Face and bypass damper settings at coils.
   e. Fan drive settings including settings and percentage of maximum pitch diameter.
   f. Inlet vane settings for variable-air-volume systems.
   g. Settings for supply-air, static- pressure controller.
   h. Other system operating conditions that affect performance.
16. Quantities of outdoor, supply, return, and exhaust airflows.
17. Water and steam flow rates.
18. Duct, outlet, and inlet sizes.
19. Pipe and valve sizes and locations.
20. Terminal units.

D. Heat Pump 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, and bore.
   i. Center-to-center dimensions of sheave and amount of adjustments in inches.
   j. Number, make, and size of belts.
   k. Number, type, and size of filters.

2. Motor Data:
1. Motor make, and frame type and size.
2. Horsepower and rpm.
3. Volts, phase, and hertz.
4. Full-load amperage and service factor.
5. Sheave make, size in inches, and bore.
6. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Heating-coil static-pressure differential in inches wg.
   i. Outdoor airflow in cfm.
   j. Return airflow in cfm.
   k. Outdoor-air damper position.
   l. Return-air damper position.
   m. Vortex damper position.

E. Apparatus-Coil Test Reports:

1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
   f. Make and model number.
   g. Face area in sq. ft..
   h. Tube size in NPS.
   i. Tube and fin materials.
   j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in gpm.
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.
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, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

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, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Suction static pressure in inches wg.

G. 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.
   d. Duct static pressure in inches wg.
   e. Duct size in inches.
   f. Duct area in sq. ft..
   g. Indicated airflow rate in cfm.
   h. Indicated velocity in fpm.
   i. Actual airflow rate in cfm.
   j. Actual average velocity in fpm.
   k. Barometric pressure in psig.

H. 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.
2. Test Data (Indicated and Actual Values):

   a. Airflow rate in cfm.
   b. Air velocity in fpm.
   c. Preliminary airflow rate as needed in cfm.
   d. Preliminary velocity as needed in fpm.
   e. Final airflow rate in cfm.
   f. Final velocity in fpm.
   g. Space temperature in deg F.

I. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

   1. Unit Data:

      a. Unit identification.
      b. Location.
      c. Service.
      d. Make and size.
      e. Model number and serial number.
      f. Water flow rate in gpm.
      g. Water pressure differential in feet of head or psig.
      h. Required net positive suction head in feet of head or psig.
      i. Pump rpm.
      j. Impeller diameter in inches.
      k. Motor make and frame size.
      l. Motor horsepower and rpm.
      m. Voltage at each connection.
      n. Amperage for each phase.
      o. Full-load amperage and service factor.
      p. Seal type.

   2. Test Data (Indicated and Actual Values):

      a. Static head in feet of head or psig.
      b. Pump shutoff pressure in feet of head or psig.
      c. Actual impeller size in inches.
      d. Full-open flow rate in gpm.
      e. Full-open pressure in feet of head or psig.
      f. Final discharge pressure in feet of head or psig.
      g. Final suction pressure in feet of head or psig.
      h. Final total pressure in feet of head or psig.
      i. Final water flow rate in gpm.
      j. Voltage at each connection.
      k. Amperage for each phase.

J. Instrument Calibration Reports:

   1. Report Data:

      a. Instrument type and make.
      b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

END OF SECTION 230593
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 insulating the following duct services:
   1. Indoor, concealed supply, return and outdoor air.
   2. Indoor, exposed supply return, and outdoor air.
B. Related Sections:
   1. Section 230719 "HVAC Piping Insulation."
   2. Section 233113 "Metal Ducts" for duct liners.

1.3 DEFINITIONS
A. Concealed Duct: Duct located within chases, soffits, return air (ceiling) plenums, and other concealed locations of a similar fashion.
B. Exposed Duct: Duct exposed to view within the conditioned spaces.
C. Conditioned Space: Space with active heating and cooling maintaining a space temperature set point anywhere between 55 degree F and 85 degree F. Mechanical rooms, electrical rooms and ceiling plenums are NOT conditioned spaces.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.5 QUALITY ASSURANCE
A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
1.6 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.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 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 "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket or Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

G. 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 ASJ or with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; 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, provide one of the following:
   b. Eagle Bridges - Marathon Industries; 225.
   d. Mon-Eco Industries, Inc.; 22-25.


1. Products: Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges - Marathon Industries; 225.
   d. Mon-Eco Industries, Inc.; 22-25.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 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 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:

   b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.


2.4 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 491 AWF FSK.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.

3. Thickness: 6.5 mils.


5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch in width.

7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.5 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. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.

   a. Products: Subject to compliance with requirements, provide one of 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, 0.135-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

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

      1) AGM Industries, Inc.; CHP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel or aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

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

      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.

   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annaeled, galvanized steel.

### 2.6 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. 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.

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 ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
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.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not overcompress insulation during installation.
      e. Impale insulation over pins and attach speed washers.
      f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
   4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch
o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not overcompress insulation during installation.

e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface.
Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

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-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FINISHES

A. Exposed duct in occupied conditioned spaces that is not required to have a field installed PVC jacket shall have the insulation ASJ or other Paintable Jacket material painted with a color selected by Architect

B. Insulation with ASJ, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flan 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.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.7 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed outdoor air.

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.
   5. Flexible connectors.
   7. Factory-insulated access panels and doors.

3.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply/return-air duct and plenum insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
B. Concealed, round and flat-oval, outdoor-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Concealed, rectangular, outdoor-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

D. Exposed, round and flat-oval, outdoor-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

END OF SECTION 230713
SECTION 230719
HVAC PIPING 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 insulating the following HVAC piping systems:
   1. Condensate drain piping, indoors.
   2. Condenser-water piping, indoors.
B. Related Sections:
   1. Section 230713 "Duct Insulation."

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 QUALITY ASSURANCE
A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to 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 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 sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping 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.

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


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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. **Products:** Subject to compliance with requirements, provide one of the following:

   a. Aeroflex USA, Inc.; Aerocel.
   b. Armacell LLC; AP Armaflex.
   c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. **Products:** Subject to compliance with requirements, provide one of the following:

   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory-applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Knauf Insulation; Permawick Pipe Insulation.
   b. Owens Corning; VaporWick Pipe Insulation.

2.2 INSULATING CEMENTS


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. Ramco Insulation, Inc.; Super-Stik.

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. 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 LLC; Armaflex 520 Adhesive.
   d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
b. Eagle Bridges, Marathon Industries; 225.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 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-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 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 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:

   b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.


2.5 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.

3. Thickness: 11.5 mils.


5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.6 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. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

1. PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems 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. *Carbon Steel:* Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. 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 piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of 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. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. 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.
   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 below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping 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 Section 078413 "Penetration Firestopping."

3.5 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. 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. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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.
   3. 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.
   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.
3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.8 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
   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.
B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Condenser-Water Supply and Return:

1. NPS 12 and Smaller: Insulation shall be one of the following:
   b. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.

3.11 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 230719
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. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.

B. Related Requirements:
   1. Section 230923.17 "Level Instruments" for liquid-level switches, sensors, and transmitters that connect to DDC systems.
   2. Section 230923.22 "Position Instruments" for limit switches that connect to DDC systems.
   3. Section 230993 "Sequence of Operations for HVAC Controls" for control sequences in DDC systems.

1.3 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. BACnet Specific Definitions:
   2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
   3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
   5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.
D. Binary: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a
low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used
interchangeably with "Binary" to indicate a two-state signal.

E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on
a network, used for local or global control. Three types of controllers are indicated: Network
Controller, Programmable Application Controller, and Application-Specific Controller.

F. Control System Integrator: An entity that assists in expansion of existing enterprise system and
support of additional operator interfaces to I/O being added to existing enterprise system.

G. COV: Changes of value.

H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer
and responsible for execution of DDC system Work indicated.

I. Distributed Control: Processing of system data is decentralized and control decisions are made
at subsystem level. System operational programs and information are provided to remote
subsystems and status is reported back. On loss of communication, subsystems shall be
capable of operating in a standalone mode using the last best available data.

J. DOCSIS: Data-Over Cable Service Interface Specifications.

K. E/P: Voltage to pneumatic.

L. Gateway: Bidirectional protocol translator that connects control systems that use different
communication protocols.

M. HLC: Heavy load conditions.

N. I/O: System through which information is received and transmitted. I/O refers to analog input
(AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are
continuous and represent control influences such as flow, level, moisture, pressure, and
temperature. Binary signals convert electronic signals to digital pulses (values) and generally
represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used
interchangeably with "Binary," (BI) and (BO), respectively.

O. I/P: Current to pneumatic.

P. LAN: Local area network.

Q. LNS: LonWorks Network Services.

R. LON Specific Definitions:

1. FTT-10: Echelon Transmitter-Free Topology Transceiver.
2. LonMark: Association comprising suppliers and installers of LonTalk products. Association provides guidelines for implementing LonTalk protocol to ensure interoperability through a standard or consistent implementation.
3. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a
"Neuron Chip" for communication. LonTalk is a register trademark of Echelon.
4. LonWorks: Network technology developed by Echelon.
5. Node: Device that communicates using CEA-709.1-C protocol and that is connected to a
CEA-709.1-C network.
6. Node Address: The logical address of a node on the network, consisting of a Domain number, Subnet number, and Node number. "Node number" portion of an address is a number assigned to device during installation, is unique within a subnet, and is not a factory-set unique Node ID.

7. Node ID: A unique 48-bit identifier assigned at factory to each CEA-709.1-C device. Sometimes called a "Neuron ID."

8. Program ID: An identifier (number) stored in a device (usually EEPROM) that identifies node manufacturer, functionality of device (application and sequence), transceiver used, and intended device usage.


10. Standard Network Variable Type (SNVT): Pronounced "snivet." A standard format type maintained by LonMark used to define data information transmitted and received by individual nodes. "SNVT" is used in two ways. It is an acronym for "Standard Network Variable Type" and is often used to indicate a network variable itself (i.e., it can mean "a network variable of a standard network variable type").

11. Subnet: Consists of a logical grouping of up to 127 nodes, where logical grouping is defined by node addressing. Each subnet is assigned a number, which is unique within a Domain. See "Node Address."

12. TP/FT-10: Free Topology Twisted Pair network defined by CEA-709.3 and is most common media type for a CEA-709.1-C control network.

13. TP/XF-1250: High-speed, 1.25-Mbps, twisted-pair, doubly terminated bus network defined by "LonMark Interoperability Guidelines" typically used only to connect multiple TP/FT-10 networks.

14. User-Defined Configuration Property Type (UCPT): Pronounced "U-Keep-It." A Configuration Property format type that is defined by device manufacturer.

15. User-Defined Network Variable Type (UNVT): Network variable format defined by device manufacturer. UNVTs create non-standard communications that other vendors’ devices may not correctly interpret and may negatively impact system operation. UNVTs are not allowed.

S. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

T. Modbus TCP/IP: An open protocol for exchange of process data.

U. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.

V. MTBF: Mean time between failures.

W. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.

X. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.

Y. PDA: Personal digital assistant.

Z. Peer to Peer: Networking architecture that treats all network stations as equal partners.
AA. POT: Portable operator’s terminal.
BB. PUE: Performance usage effectiveness.
CC. RAM: Random access memory.
DD. RF: Radio frequency.
EE. Router: Device connecting two or more networks at network layer.
FF. Server: Computer used to maintain system configuration, historical and programming database.
GG. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
HH. UPS: Uninterruptible power supply.
II. USB: Universal Serial Bus.
JJ. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.
KK. VAV: Variable air volume.
LL. WLED: White light emitting diode.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
4. Installation, operation and maintenance instructions including factors effecting performance.
   a. Instruments.
   b. Control valves and actuators.
5. When manufacturer’s product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
6. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

B. Shop Drawings:

1. General Requirements:
a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.

2. Schematic drawings for each controlled HVAC system indicating the following:
   a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
   b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
   c. A graphic showing location of control I/O in proper relationship to HVAC system.
   d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
   e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
   f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
   g. Narrative sequence of operation.
   h. Graphic sequence of operation, showing all inputs and output logical blocks.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates:
   1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
      b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
      c. As-built versions of submittal Product Data.
      d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
      e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
      f. Licenses, guarantees, and warranty documents.
      g. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
h. Owner training materials.

1.7 WARRANTY

A. Manufacturer’s Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.
   a. Install updates only after receiving Owner’s written authorization.
3. Warranty Period: One year(s) from date of Substantial Completion.

1.8 SEQUENCE OF OPERATION

A. See mechanical drawings for control drawings and sequence of operation. These drawings show general intent and minimum point requirements. If more real or virtual points are required to provide the sequences noted, it is the instrumentation and control contractor’s responsibility to provide the additional equipment, accessories and programming time necessary to perform these sequences.

B. Where control drawings and sequence of operation are not identified, industry standard sequences and control devices shall be provided to accommodate proper system operation and safety control of all devices specified in Division 22 and Division 23.

C. Unless specifically noted otherwise modulate/staging down sequences shall be the opposite of the modulate/staging up sequence shown.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Control components and sequences shall be directly integrated into existing building DDC system. Field coordinate prior to bidding.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

B. Environmental Conditions for Instruments and Actuators:
1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

2. Instruments, actuators and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments and actuators not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
   a. Indoors, Heated and Air-conditioned: Type 1.

2.3 CONTROL WIRE AND CABLE

A. Electronic and fiber-optic cables for control wiring shall comply with the requirements listed below.

1. All control devices and panels containing low voltage power sources shall inherently comply with NEC Class 2 requirements (current limiting), or shall be supplied with branch circuit fusing to limit control circuit current to NEC Class 2. All control transformers shall be of the inherent current limiting type, or shall be installed with primary disconnects and overload protection.

2. Shielded Cable: Twisted shielded cable shall be used where called for and where required to properly protect the DDC system from false signals and electrical noise. Shielding shall be fine braided tinned copper (90% coverage) or aluminum foil (100% coverage).

3. Minimum Requirements:
   a. Communication Cable: Twisted shielded pair, 18 gauge.
   b. Analog Input: Twisted shielded two, three, or four-wire as required, 18 gauge
   c. Binary Input: 18 gauge.
   d. Analog Output: Twisted shielded, 18 gauge.
   e. Binary Output: 18 gauge.

2.4 RACEWAYS FOR CONTROL WIRING, CABLING, AND TUBING

A. Metal Conduits, Tubing, and Fittings:
   1. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. GRC: Comply with NEMA ANSI C80.1 and UL 6.
   3. IMC: Comply with NEMA ANSI C80.6 and UL 1242.
   4. FMC: Comply with UL 1; zinc-coated steel or aluminum.
   5. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
   6. Fittings for Metal Conduit: Comply with NEMA ANSI FB 1 and UL 514B.
2.5 CONTROL POWER WIRING AND RACEWAYS

A. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" electrical power conductors and cables.

B. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

2.6 ACCESSORIES

A. Pressure Electric Switches:
   1. Diaphragm-operated snap acting switch.
   2. Set point adjustable from 3 to 20 psig.
   3. Differential adjustable from 2 to 6 psig.
   4. Rated for resistance loads at 120-V ac.
   5. Body and switch housing shall be metal.

2.7 IDENTIFICATION

A. Valve Tags:
   1. Brass tags and brass chains attached to valve.
   2. Tags shall be at least 1.5 inches in diameter.
   3. Include tag with unique valve identification indicating control influence such as flow, level, pressure, or temperature; followed by location of valve, and followed by three-digit sequential number. For example: TV-1.001.
   4. Valves with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.
   1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
   2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.
D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Communication Interface to Equipment with Integral Controls:

1. DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.

2. Equipment to Be Connected:
   a. Fan-coil units specified in Section 238146 "Water Source Heat Pumps"

3.3 DDC SYSTEM INTERFACE WITH EXISTING SYSTEMS

A. Interface with Existing Systems:

1. DDC systems shall interface existing systems to achieve integration.

3.4 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.

B. Deliver the following to plumbing and HVAC piping installers for installation in piping. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. DDC control valves, which are specified in Section 230923.11 "Control Valves."

3.5 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment.

D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop penetrations made in fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079200 "Joint Sealants."

H. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

I. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

3.6 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to DDC system products requiring electrical power connections.

B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.

C. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.

D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.

E. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification products and installation.

B. Install engraved phenolic nameplate with identification on face of each control valve actuator connected to a DDC controller.

3.8 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NECA 1.

B. Comply with TIA 568-C.1.

C. Wiring Method: Install cables in raceways and cable trays except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

   1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

E. Field Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

F. Conduit Installation:
   1. Install conduit expansion joints where conduit runs exceed 200 feet, and conduit crosses building expansion joints.
   2. Coordinate conduit routing with other trades to avoid conflicts with ducts, pipes and equipment and service clearance.
   3. Maintain at least 3-inch separation where conduits run axially above or below ducts and pipes.
   4. Limit above-grade conduit runs to 100 feet without pull or junction box.
   5. Do not install raceways or electrical items on any "explosion-relief" walls, or rotating equipment.
   6. Do not fasten conduits onto the bottom side of a metal deck roof.
   7. Flexible conduit is permitted only where flexibility and vibration control is required.
   8. Limit flexible conduit to 3 feet long.
   9. Conduit shall be continuous from outlet to outlet, from outlet to enclosures, pull and junction boxes, and shall be secured to boxes in such manner that each system shall be electrically continuous throughout.

G. Wire and Cable Installation:
   1. Cables serving a common system may be grouped in a common raceway. Install control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
   2. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.
      a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.
   3. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
   4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
   5. UTP Cable Installation:
      a. Comply with TIA 568-C.2.
      b. Do not untwist UTP cables more than 1/2 inch from the point of termination, to maintain cable geometry.
6. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

7. Provide strain relief.

8. Terminate wiring in a junction box.
   a. Clamp cable over jacket in junction box.
   b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.

9. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.

10. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.

11. Keep runs short. Allow extra length for connecting to terminal boards. Do not bend flexible coaxial cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.

12. Ground wire shall be copper and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

13. Wire and cable shall be continuous from terminal to terminal without splices.

14. Use insulated spade lugs for wire and cable connection to screw terminals.

15. Use shielded cable to transmitters.

16. Use shielded cable to temperature sensors.

17. Perform continuity and meager testing on wire and cable after installation.

18. Do not install bruised, kinked, scored, deformed, or abraded wire and cable. Remove and discard wire and cable if damaged during installation, and replace it with new cable.

19. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

20. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.


   a. Comply with BICSI TDMM and TIA 569-C for separating unshielded cable from potential EMI sources, including electrical power lines and equipment.

   b. Separation between open cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

      1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
      2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.

   c. Separation between cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

      1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
      2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.

   d. Separation between cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
1) Electrical Equipment Rating Less Than 2 kVA: No requirement.
2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.

3.9 FIELD QUALITY CONTROL

A. Perform the following 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. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Testing:
1. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.
2. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
3. Test Results: Record test results and submit copy of test results for Project record.

3.10 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.

E. Control Valve Checkout:
1. Verify that control valves are installed correctly for flow direction.
2. Verify that valve body attachment is properly secured and sealed.
3. Verify that valve actuator and linkage attachment is secure.
4. Verify that actuator wiring is complete, enclosed and connected to correct power source.
5. Verify that valve ball, disc or plug travel is unobstructed.
6. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

F. Instrument Checkout:
1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.
4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:
   a. Verify sensing element type and proper material.
   b. Verify length and insertion.

3.11 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.

C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.

D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.

E. Provide diagnostic and test equipment for calibration and adjustment.

F. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.

G. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.

H. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

I. Analog Signals:
   1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
   2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
   3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

J. Digital Signals:
   1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact making or breaking.

K. Control Valves:

1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

L. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

M. Switches: Calibrate switches to make or break contact at set points indicated.

N. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

END OF SECTION 230923
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 control valves and actuators for DDC systems.
B. Related Requirements:
1. Section 230923 "Direct-Digital Control System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 DEFINITIONS
A. Cv: Design valve coefficient.
B. DDC: Direct-digital control.
C. NBR: Nitrile butadiene rubber.
D. PTFE: Polytetrafluoroethylene
E. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product, including the following:
1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
4. Installation, operation, and maintenance instructions, including factors affecting performance.
B. Shop Drawings:
   1. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Determine control valve sizes and flow coefficients by ISA 75.01.01.

D. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

E. Selection Criteria:
   1. Control valves shall be suitable for operation at following conditions:
      a. Condenser Water: 175 psig and 160°F.
   2. Control valve shutoff classifications shall be FCI 70-2, Class IV or better unless otherwise indicated.
   3. Valve pattern, three-way or straight through, shall be as indicated on Drawings.
   4. Modulating straight-through pattern control valves shall have equal percentage flow-throttling characteristics unless otherwise indicated.
   5. Fail positions unless otherwise indicated:
      a. Condenser Water: Open.
   6. Rotary-type control valves, such as ball and butterfly valves, shall have Cv falling between 65 and 75 degrees of valve full open position and minimum valve Cv between 15 and 25 percent of open position.
   7. Selection shall consider viscosity, flashing, and cavitation corrections.
   8. Valves shall have stable operation throughout full range of operation, from design to minimum Cv.
   9. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
   10. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow unless otherwise indicated.
   11. Two-position control valves shall be line size unless otherwise indicated.
   12. In water systems, use ball- control valves for two-position control for valves NPS 2 and smaller.
2.2 ZONE CONTROL VALVES

A. Zone Valves (On/Off Two-Position Applications):
   1. NPS 1 and Smaller: Forged ASTM B61, B62, B584 bronze or “Dezincification Resistant” ASTM B371, B99 brass body rated at no less than 300 psi, stainless steel stem, female, NPT union or sweat with a stainless steel stem and EPDM seals.
   2. Sizing:
      3. Two-Position: Line size or size using a pressure differential of 1 psi.
      4. Close-Off Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system head pressure for two-way valves and 125 percent of the design pressure differential across the three-way valves.
      5. The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory.
      6. The manufacturer shall warrant all components for a period of 2 years from the date of production.
      7. All zone valves for individual coil control shall be provided as part of a pipe package supplied by the valve manufacturer. The supply side of the coil shall contain a strainer/shut-off ball valve/drain with a P/T port. The return side of the coil shall contain a union fitting with a P/T port, zone valve, an integrated manual balancing valve/union/isolation ball valve/manual air vent with P/T port. Shut-off valves as an integrated part of the zone valve are prohibited. A 24” flexible hose set shall be provided for each coil supply and return connection for all pipe packages. All package component bodies shall be ASTM B61, B62, B584 bronze or ASTM B371, B99 brass that are “Dezincification Resistant.”

2.3 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

B. Position indicator and graduated scale on each actuator.

C. Type: Motor operated, with or without gears, electric and electronic.

D. Voltage: 24-V ac.

E. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

F. Function properly within a range of 85 to 120 percent of nameplate voltage.

G. Construction:
   1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
   2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
   3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

H. Field Adjustment:
1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

I. Two-Position Actuators: Single direction, spring return or reversing type.

J. Fail-Safe:
   1. Where indicated, provide actuator to fail to an end position.
   2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
   3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

K. Valve Attachment:
   1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
   2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
   3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

L. Temperature and Humidity:
   1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.

M. Enclosure:
   1. Suitable for ambient conditions encountered by application.

N. Stroke Time:
   1. Operate valve from fully closed to fully open within 60 seconds.
   2. Operate valve from fully open to fully closed within 60 seconds.
   3. Move valve to failed position within 30 seconds.
   4. Select operating speed to be compatible with equipment and system operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for valves installed in piping to verify actual locations of piping connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

D. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Valve Orientation:
   1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
   2. Install valves in a position to allow full stem movement.

D. Clearance:
   1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
   2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.

E. Threaded Valves:
1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

F. Flanged Valves:
1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.5 CONNECTIONS
A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 “Grounding and Bonding for Electrical Systems.”

3.6 IDENTIFICATION
A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 “Identification for Electrical Systems.”
B. Install engraved phenolic nameplate with valve identification on valve.

3.7 CLEANING
A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.
B. Wash and shine glazing.
C. Polish glossy surfaces to a clean shine.

3.8 CHECKOUT PROCEDURES
A. Control Valve Checkout:
1. Check installed products before continuity tests, leak tests, and calibration.
2. Check valves for proper location and accessibility.
3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. Verify that control valves are installed correctly for flow direction.
5. Verify that valve body attachment is properly secured and sealed.
6. Verify that valve actuator and linkage attachment are secure.
7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
8. Verify that valve ball, disc, and plug travel are unobstructed.
9. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.9 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

END OF SECTION 230923.11
SECTION 232113
HYDRONIC 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 pipe and fitting materials and joining methods for the following:
   1. Condenser-water piping, which includes geothermal and standard heat pump loop systems.
   2. Condensate-drain piping.
   3. Air-vent piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Pressure-seal fittings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
1. Condenser-Water Piping: 160 psig at 150 deg F.
2. Condensate-Drain Piping: 150 deg F.
3. Air-Vent Piping: 200 deg F.
4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L ASTM B 88, Type M.
B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
C. DWV Copper Tubing: ASTM B 306, Type DWV.
   1. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
   2. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting.
      Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
E. Copper or Bronze Pressure-Seal Fittings:
   1. Housing: Copper.
   2. O-Rings and Pipe Stops: EPDM.
   3. Tools: Manufacturer's special tools.
   4. Minimum 200-psig working-pressure rating at 250 deg F.
F. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.
   1. T-Drill Industries, Inc.
G. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   2. End Connections: Butt welding.
   3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:
   1. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   2. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elster Perfection.
   b. Grinnell Mechanical Products.
   c. Matco-Norca, Inc.
   d. Perfection Corporation
   e. Precision Plumbing Products, Inc.
   f. Victaulic Company.

2. Description:
   b. Electroplated steel nipple, complying with ASTM F 1545.
   c. Pressure Rating: 300 psig at 225 deg F.
   d. End Connections: Male threaded or grooved.
   e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Condenser-water piping, aboveground, NPS 3 and smaller, shall be any of the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed or pressure-seal joints.
   2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Condensate-Drain Piping: Type M Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

C. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
   2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

D. Safety-Valve-Inlet and -Outlet Piping for Condenser-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

N. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

O. Install valves according to Section 230523.11 "Ball Valves for HVAC Piping," Section 230523.14 "Check Valves for HVAC Piping."

P. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

Q. Install shutoff valve immediately upstream of each dielectric fitting.

R. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."
3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 3 and Smaller: Use dielectric nipples.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 “Hangers and Supports for HVAC Piping and Equipment” for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
   2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 7 feet.
   2. NPS 1: Maximum span, 7 feet.
   3. NPS 1-1/2: Maximum span, 9 feet.
   4. NPS 2: Maximum span, 10 feet.
   5. NPS 2-1/2: Maximum span, 11 feet.
   6. NPS 3 and Larger: Maximum span, 12 feet.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
   2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
   3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
   4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

3.5 PIPE 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 pipe and fittings before assembly.

C. 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/A5.8M.
D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

H. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

I. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113
SECTION 232116
HYDRONIC 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. Section includes special-duty valves and specialties for the following:
   1. Condenser-water piping.
   2. Condensate-drain piping.
   3. Air-vent piping.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of the following:
   1. Valves: Include flow and pressure drop curves based on manufacturer’s testing for calibrated-orifice balancing valves and automatic flow-control valves.
   2. Air-control devices.
   3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS
A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE
A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Condenser-Water Piping: 160 psig at 150 deg F
   2. Condensate-Drain Piping: 150 deg F
   3. Air-Vent Piping: 200 deg F.
   4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

A. Check, Ball Valves: Comply with requirements specified in Section 230523.12 "Ball Valves for HVAC Piping," and Section 230523.14 "Check Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230923.11 "Control Valves."

C. Bronze, Calibrated-Orifice, Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong Pumps, Inc.
      b. Bell & Gossett Domestic Pump; a division of ITT Industries.
      c. Flow Design Inc.
      d. Gerard Engineering Co.
      e. Griswold Controls.
      f. Taco.
   2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
   3. Ball: Brass or stainless steel.
   4. Plug: Resin.
   5. Seat: PTFE.
   6. End Connections: Threaded or socket.
   8. Handle Style: Lever, with memory stop to retain set position.
   10. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong Pumps, Inc.
      b. Bell & Gossett Domestic Pump; a division of ITT Industries.
      c. Flow Design Inc.
      d. Gerard Engineering Co.
      e. Griswold Controls.
      f. Taco.
      g. Tour & Andersson; available through Victaulic Company.
   2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
   3. Ball: Brass or stainless steel.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
9. Handle Style: Lever, with memory stop to retain set position.
11. Maximum Operating Temperature: 250 deg F.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amtrol, Inc.
      b. Armstrong Pumps, Inc.
      c. Bell & Gossett Domestic Pump; a division of ITT Industries.
      d. Conbraco Industries, Inc.
      e. Spence Engineering Company, Inc.
      f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Body: Bronze or brass.
   3. Disc: Glass and carbon-filled PTFE.
   5. Stem Seals: EPDM O-rings.
   6. Diaphragm: EPT.
   8. Inlet Strainer: removable without system shutdown.
   10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Control Valves:
   1. Calibrated Balancing Valves and Automatic Flow-Control Valves shall not be required on devices where pressure independent control valves are installed. Positive shut off isolation valves will be required.

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:
   1. Body: Bronze.
   2. Internal Parts: Nonferrous.
   3. Operator: Screwdriver or thumbscrew.
   4. Inlet Connection: NPS 1/2.
   7. Maximum Operating Temperature: 225 deg F.

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.

B. Stainless-Steel Bellow, Flexible Connectors:
   2. End Connections: Threaded or flanged to match equipment connected.
   4. CWP Rating: 150 psig.
   5. Maximum Operating Temperature: 250 deg F.

C. Spherical, Rubber, Flexible Equipment Connectors:
   2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
   4. CWP Rating: 150 psig.
   5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves on closed system condenser water systems. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

3.3 EXISTING PIPING SYSTEMS

A. Where existing piping system is maintained and only “hot taps” or existing valves are used as connection points, flush and clean the components in advance of connecting to the existing system.
B. Once the new work is attached to the system and the installation has been completed, pressure test the system in its entirety as a complete system. Anticipate leaks will occur in the existing piping system, coordinate with the Owner at the time of the pressure test and aid the Owner in identification of leaks which they will repair.

C. Upon completion of an acceptable pressure test, flush the system in its entirety. Provide sufficient chemicals and flow to clean and flush the system as a whole.

END OF SECTION 232116
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.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and
balancing requirements for metal ducts.
2. Section 233300 "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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
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 2-1, “Rectangular Duct/Transverse 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 2-2, “Rectangular Duct/Longitudinal Seams,” 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 4, “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:

   a. Cobb Mechanical
   b. Hercules Industries
   c. Lindab Inc.
   d. McGill AirFlow LLC.
   e. Metco Inc.
   f. SEMCO Incorporated.
   g. Sheet Metal Connectors, Inc.
   h. Spiral Manufacturing Co., Inc.
   i. Spir-O-Lock Spiral Pipe of Texas
   j. Superior

B. Longitudinal Seams: Select seam types and fabricate according to SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible,” Figure 3-2, “Round Duct Longitudinal Seams,” 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." Allowable seam types shall be RL-1 (spiral seam), RL-2/3 (lap and rivet or tack weld) and RL-4 (butt-welded) as identified in Figure 3-2 "Round Duct Longitudinal Seams" of the above reference standard.

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

C. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. 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.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation; Insulation Group.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.
      e. Maximum Thermal Conductivity:
         1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

   a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:

   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel or aluminum; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

   3. Butt transverse joints without gaps, and coat joint with adhesive.

   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

   6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

   7. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

   1. Application Method: Brush on.

   2. Solids Content: Minimum 65 percent.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.
   2. Type: S.
   3. Grade: NS.
   5. Use: O.
   6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum 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 static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. 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.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible” unless otherwise indicated.

C. Install round 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, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

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."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "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.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. 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.

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 Section 233300 "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.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections. Pressurize all tests and repair and seal all audible leaks.

B. Duct system will be considered defective if it does not pass tests and inspections.
3.8 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows or as indicated in the supply, return, exhaust and outdoor air duct schedules noted below:

B. Supply, Return and Exhaust Ducts:

1. Ducts Connected to Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units:
   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round: 12.

3. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:
   a. Type 316, stainless-steel sheet.
      1) Exposed to View: No. 4 finish.
   b. PVC-coated, galvanized sheet steel with thicker coating on duct interior.
   c. Pressure Class: Positive or negative 3-inch wg.
   d. Minimum SMACNA Seal Class: A.
   e. SMACNA Leakage Class: 3.

C. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
2. PVC-Coated Ducts:
   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Match duct material.

3. Stainless-Steel Ducts:
   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Match duct material.

D. Liner:
1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "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 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "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) Radius-to-Diameter Ratio: 1.5.
   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

**END OF SECTION 233113**
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:
   2. Flange connectors.
   3. Turning vanes.
   4. Flexible connectors.
   5. Flexible ducts.
   6. Duct accessory hardware.
B. Related Requirements:

1.3 ACTION SUBMITTALS
A. Shop Drawings: For duct accessories.
   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:
      b. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION
B. 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.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60 or G90.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance Inc.; a division of Mestek, Inc.
   2. American Warming and Ventilating; a division of Mestek, Inc.
   3. Cesco Products; a division of Mestek, Inc.
   5. Nailor Industries Inc.
   6. Pottorff.
   7. Ruskin Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 1000 fpm.

D. Maximum System Back Pressure: 3-inch wg.

E. Frame: Hat-shaped, 0.05-inch- thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, center/off-center/end pivoted, maximum 6-inch width, 0.050-inch- thick aluminum sheet with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.

I. Blade Axles:
1. Material: Galvanized steel, Stainless steel, Nonmetallic or Aluminum.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum or Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: 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.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. Flexmaster U.S.A., Inc.
   d. McGill AirFlow LLC.
   e. Nailor Industries Inc.
   f. Pottorff.
   g. Ruskin Company.
2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:
   a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 inch thick.
7. Bearings:
   a. Oil-impregnated bronze or Molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg 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.
2.5 TURNING VANES

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.

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.

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 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

2.6 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.


1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.7 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.

B. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
3. Temperature Range: Minus 20 to plus 210 deg F.

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, to suit duct size.

2.8 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where 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 flexible connectors to connect ducts to equipment.

H. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

I. Connect flexible ducts to metal ducts with stainless-steel band with worm-gear. Tape outer vapor barrier securely over clamp with vapor barrier tape.

J. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300
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. Utility set fans.
2. Centrifugal roof ventilators.
3. Axial roof ventilators.
4. Upblast propeller roof exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Dampers, including housings, linkages, and operators.
5. Roof curbs.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.
1.5 INFORMATIONAL SUBMITTALS
   A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
      1. Roof framing and support members relative to duct penetrations.
      2. Ceiling suspension assembly members.
      3. Size and location of initial access modules for acoustical tile.
      4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      1. Belts: One set(s) for each belt-driven unit.

1.8 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.
   B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
   C. UL Standards: Power ventilators shall comply with UL 705.

1.9 COORDINATION
   A. Coordinate size and location of structural-steel support members.
   B. Coordinate sizes and locations of concrete bases with actual equipment provided.
   C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
PART 2 - PRODUCTS

2.1 UTILITY SET FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Aerovent; a Twin City Fan Company.
   3. Ammerman; General Resource Corp.
   4. Breidert Air Products.
   5. Carnes Company HVAC.
   7. JencoFan; Div. of Breidert Air Products.
   8. Loren Cook Company.

B. Housing: Fabricated of steel with side sheets fastened with a deep lock seam or welded to scroll sheets. All interior and exterior surface steel shall be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked.

C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.
   1. Blade Type: Backward inclined.

D. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

E. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L50 of 400,000 hours.
   1. Extend grease fitting to accessible location outside of unit.

F. Belt Drives:
   1. Factory mounted, with final alignment and belt adjustment made after installation
   2. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

G. Accessories:
   1. Discharge stack. Minimum unit height to be 10 feet from the roof deck. Stack material to be coated with a minimum of 2-4 mils of polyester urethane. Stack to match outlet dimensions of the fan and shall not add additional static pressure drop to the exhaust fan. Stack discharge shall have tapered design increasing exit velocity and not adding additional static pressure drop to the exhaust fan. When properly anchored to the roof structure, the standard fan / stack assembly shall withstand wind loads of up to 22 PSF (pounds per square foot), equivalent to 92 mph (miles per hour) windspeed, without the need for guy wires or additional structural support.
   2. Fan shall be provided with integral inlet box and curb cap constructed of same material, with access panel for inspection of fan wheel and duct. It will be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL-7023, concrete grey. Inlet box shall not increase static pressure resistance to the exhaust fan.
3. Units with integral inlet box shall be provided with matching roof curb. Roof curb shall be constructed of 14 ga. galvanized steel, include one inch of insulation and be provided with adjustable duct support bar for connecting building duct to roof curb. Roof curb shall be equivalent in construction to Greenheck model GPFHL

4. Units with integral inlet box shall be provided with gravity, back draft damper to prevent airflow back into the building when exhaust fan is not in operation. Damper sized to match inlet area of inlet box and mounted in the roof curb. Back draft damper shall be constructed with aluminum frame, extruded aluminum blades and vinyl seals on closing edge. Damper shall be equivalent to Greenheck model EM-10

5. Companion Flanges: Rolled flanges for duct connections of same material as housing.
6. Inlet Screens: Removable wire mesh.
8. Weather Hoods: An OSHA compliant weather resistant hood with stamped vents over motor and drive compartment.

H. Capacities and Characteristics: As Scheduled on Drawings

2.2 UPBLAST PROPELLER ROOF EXHAUST FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Aerovent; a Twin City Fan Company.
   3. Ammerman; General Resource Corp.
   4. Breidert Air Products.
   5. Carnes Company HVAC.
   7. JencoFan; Div. of Breidert Air Products.
   8. Loren Cook Company.

B. Wind Band, Fan Housing, and Base: Reinforced and braced aluminum, containing aluminum butterfly dampers and rain trough, motor and drive assembly, and fan wheel.
   1. Damper Rods: Steel with bronze bearings.
   2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheel: Replaceable, aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

D. Belt Drives:
   1. Resiliently mounted to housing.
   2. Weatherproof housing of same material as fan housing.
   3. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
E. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches.

F. Capacities and Characteristics: As scheduled on drawings.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "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.

2.4 SOURCE QUALITY CONTROL

A. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

C. Install units with clearances for service and maintenance.

D. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 233423
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. Ceiling diffusers
   2. Registers and grilles
B. Related Sections:
   1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 DEFINITIONS
A. GRD: Grilles, Registers and Diffusers.

1.4 ACTION 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. Where requested by the Architect provide diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR ALL GRDs
A. Color and finish shall be as selected by Architect.
B. All GRDs shall be equipped with a remote balancing damper that is adjustable through the GRD face or another approved location unless supplied from an accessible take-off with locking damper.
C. Provide safety chains on all GRDs mounted to exposed duct.
D. Provide square-to-round and round-to-square adaptors as required to match specified GRD with adjoining duct.
E. GRD mounting style shall be for the ceiling, wall, floor, etc… in which they are installed. Where a GRD is used for sidewall or floor applications provide gasketing between the GRD and the finished surface.

F. Any GRDs located in a grid ceiling shall be provided with a frame mounting style suitable to match the grid type in which they are installed. On GRDs where the face size is smaller than the adjoining ceiling grid, provide the manufacturer’s frame to provide an installed face size of 12x24 inches or 24x24 inches unless noted otherwise on the Drawings.

2.2 CEILING DIFFUSERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Krueger
2. METALAIRE, Inc.
3. Nailor Industries Inc.
5. Titus.

B. See Drawing Schedule for Characteristics. See Drawing Plan for Capacities.

2.3 PERFORATED GRILLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Krueger
b. METALAIRE, Inc.
c. Nailor Industries Inc.
d. Price Industries.
e. Titus.

B. Provide duct collars as required with transition fittings to match boots and/or connected duct.

C. Where unit is not ducted or connected to a sound boot a perforated panel is acceptable.

D. See Drawing Schedule for Characteristics. See Drawing Plan for Capacities.

2.4 REGISTERS AND GRILLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Krueger
b. METALAIRE, Inc.
c. Nailor Industries Inc.
d. Price Industries.
e. Titus.

B. Sidewall exhaust and return grilles/registers to have blades fixed at approximately 35 to 45 degrees.

C. Linear bar grilles material shall be aluminum.
D. See Drawing Schedule for Characteristics. See Drawing Plan for Capacities.

2.5 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. Coordinate exact location with Architectural reflected ceiling plan. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. Paint ductwork visible behind GRDs matte black.

E. Install and support all GRDs per manufacturer's recommendations.

1. GRDs weighing less than 20 pounds shall be positively attached to ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.

2. GRDs weighing greater than 20 pounds, but not more than 56 pounds, in addition to the above, shall have two No. 12 gauge hangers connected from the terminal or service to the ceiling hangers or to the structure above. These wires may be slack.

3. GRDs weighing greater than 56 pounds shall be supported directly from the structure above by approved hangers.

F. Forward GRD A_k factors to Testing, Adjusting and Balancing Contractor.

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 238146.13
WATER-TO-AIR HEAT PUMPS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Concealed horizontal or vertical units, 6 tons and smaller.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include rated capacities, furnished specialties, and accessories for each model.
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. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS
A. Field quality-control reports.
B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For water-to-air heat pumps to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Oneset(s) of filters for each unit.
1.7 **QUALITY ASSURANCE**

A. Comply with NFPA 70.

B. Comply with safety requirements in UL 484 for assembly of free-delivery, water-source heat pumps.

C. Comply with safety requirements in UL 1995 for duct-system connections.

1.8 **WARRANTY**

A. Special Warranty: Manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.

   1. Failures include, but are not limited to, refrigeration components.

**PART 2 - PRODUCTS**

2.1 **CONCEALED WATER-SOURCE HEAT PUMPS, 6 TONS AND SMALLER**

A. [Climate Master Tranquility TY Series or prior-approved equivalent. Equivalent must be submitted during bidding questions period and must be approved in an official answer prior to bidding.](#)

B. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ASHRAE/ARI/ISO-13256-1.

   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

C. Cabinet and Chassis: Galvanized-steel casing with the following features:

   1. Access panel for access and maintenance of internal components.
   2. Knockouts for electrical and piping connections.
   3. Flanged duct connections.
   5. Units field convertible for various discharge configurations.
   6. Condensate Drainage: High-density polyethylene plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabinet.

   a. Condensate Overflow Protection Switch: Solid state electronic; mechanical float switch not permitted.

D. Fan: Direct driven, centrifugal, with multispeed motor resiliently mounted in fan inlet and with inlet rings to allow wheel removal from one side without removing housing.

   1. General requirements for motors are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
E. Water Circuit:

1. Refrigerant-to-Water Heat Exchangers:
   a. Coaxial heat exchangers with copper or cupronickel water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube are leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

2. Water-Regulating Valves: Limit water flow through refrigerant-to-water heat exchanger, and control head pressure on compressor during cooling and heating. Valves shall close when heat-pump compressor is not running.

3. Motorized Water Valve: Stop water flow through the unit when compressor is off.

F. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.

G. Refrigerant Circuit Components:


2. Charging Connections: Service fittings on suction and liquid for charging and testing on each circuit.

3. Reversing Valve: Four-way, solenoid-activated valve designed to be fail-safe in heating position with replaceable magnetic coil.

4. Compressor: Hermetic, two-stage compressor installed on vibration isolators and housed in an acoustically treated enclosure with factory-installed safeties as follows:
   a. Antirecycle timer.
   b. High-pressure cutout.
   c. Low-pressure cutout or loss of charge switch.
   d. Internal thermal-overload protection.
   e. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.
   f. Water-coil, low-temperature switch.
   g. Air-coil, low-temperature switch.


6. Pipe Insulation: Refrigerant minimum 3/8-inch-thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-developed indexes according to ASTM E 84.


H. Filters: Disposable, pleated type, 1 inch thick and with a minimum efficiency reporting value of 7 according to ASHRAE 52.2.

I. Control equipment are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC." Sequence of operation are on the drawings.

J. Controls:

1. Basic Unit Control Modes and Devices:
   a. Unit shutdown on high or low refrigerant pressures.
   b. Unit shutdown on low water temperature.
   c. Low- and high-voltage protection.
   d. Overcurrent protection for compressor and fan motor.
e. Random time delay, three to ten seconds, start on power-up.
f. Time delay override for servicing.
g. Control voltage transformer.
h. Water-coil freeze protection (selectable for water or antifreeze).
i. Air-coil freeze protection (check filter switch).
j. Condensate overflow shutdown switch.
k. Option to reset unit at thermostat or disconnect.
l. Fault type shall be retained in memory if reset at thermostat.
m. Automatic intelligent reset. Unit shall automatically reset five minutes after trip if the fault has cleared. Should a fault reoccur three times sequentially, lockout requiring manual reset occurs.
n. Ability to defeat time delays for servicing.
o. Light-emitting diodes (LED) to indicate high pressure, low pressure, low voltage, and high voltage.
p. The low-pressure switch SHALL NOT be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.
q. Remote fault-type indication at thermostat.
r. Selectable 24-V dc or pilot duty dry contact alarm output.
s. 24-V dc output to cycle a motorized water valve with compressor contactor.
t. Service test mode for troubleshooting and service.
u. Unit-performance sentinel warns when the heat pump is running inefficiently.

2. Thermostat:

a. Wall-Mounted Thermostat:
   1) Heat-cool-off switch.
   2) Fan on-auto switch.
   3) Automatic changeover.
   4) Exposed temperature set point.
   5) Exposed temperature indication.
   6) Deg F indication.

b. Unoccupied period override push button.
c. LED to indicate fault condition at heat pump.

3. Interface with DDC system for HVAC requirements as further described in Section 230923 “Direct Digital Control (DDC) System for HVAC.”

a. Interface relay for scheduled operation.
b. Interface relay to provide indication of fault at central workstation.
c. Provide BAC-net interface for central DDC system for HVAC workstation for the following functions:
   1) Set-point adjustment for set points identified in this Section.
   2) Start/stop and operating status of heat-pump unit.
   3) Data inquiry to include supply air, room air temperature and humidity, and entering-water temperature.
   4) Occupied and unoccupied schedules.

K. Electrical Connection: Single electrical connection with fused disconnect.

L. Capacities and Characteristics: As defined on drawings and schedules.
2.2 HOSE KITS

A. General: Hose kits shall be designed for minimum 400-psig working pressure and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.

B. Hose: Length 24 inches braided stainless steel, complete with adapters. Minimum diameter, equal to water-source, heat-pump connection size.

C. Isolation Valves: Two-piece, bronze-body ball valves with stainless-steel, standard-port ball and stem with normal pipe thread (NPT) connections, and galvanized-steel lever handle. Provide valve for supply and return. If balancing device is combination shutoff type with memory stop, the isolation valve may be omitted on the return.

D. Strainer: Y-type with blowdown valve in supply connection.

E. Balancing Device: Mount in return connection. Include meter ports to allow flow measurement with differential pressure gage.

F. Motorized Water Valve: Slow-acting, 24-V dc, with NPT connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduits before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting:
   1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Install wall-mounting thermostats at heights to match lighting controls or as required in Section 230923.27 "Temperature Instruments," and Section 230923 "Direct Digital Control (DDC) System for HVAC."

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
   1. Connect supply and return hydronic piping to heat pump with unions and shutoff valves.
2. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

B. Duct installation requirements are specified in other Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:

1. Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in Section 233300 “Air Duct Accessories.”

C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

D. Install piping adjacent to machine to allow service and maintenance.

E. Ground equipment according to Section 260526 “Grounding and Bonding for Electrical Systems.”

F. Connect wiring according to Section 260519 “Low-Voltage Electrical Power Conductors and Cables.”

3.4 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following field tests and inspections:

1. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Heat pumps will be considered defective if they do not pass tests and inspections.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer’s written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Adjust vibration isolators.
9. Inspect operation of barometric dampers.
10. Verify bearing lubrication on fan.
11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Adjust fan belts to proper alignment and tension.
13. Start unit according to manufacturer's written instructions.
14. Complete startup sheets and attach copy with Contractor's startup report.
15. Inspect and record performance of interlocks and protective devices; verify sequences.
16. Operate unit for an initial period as recommended or required by manufacturer.
17. Verify thermostat and humidistat calibration.
18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
20. Start refrigeration system, and measure and record the following:
   a. Coil leaving-air, dry- and wet-bulb temperatures.
   b. Coil entering-air, dry- and wet-bulb temperatures.
   c. Outdoor-air, dry-bulb temperature.
   d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
   a. Supply-air volume.
   b. Return-air volume.
   c. Relief-air volume.
   d. Outdoor-air intake volume.

3.6 ADJUSTING
   A. Adjust initial temperature set points.
   B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.7 CLEANING
   A. Replace filters used during construction prior to air balance or Substantial Completion.
   B. After completing installation of exposed, factory-finished, water-source heat pumps, inspect exposed finishes and repair damaged finishes.

3.8 DEMONSTRATION
   A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source heat pumps.

END OF SECTION 238146.13
SECTION 238239.19
WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
B. Shop Drawings:
1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include details of anchorages and attachments to structure and to supported equipment.
3. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
C. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Berko Electric Heating; a division of Marley Engineered Products.
2. Chromalox, Inc.; a division of Emerson Electric Company.
3. Indeeco.
4. Markel Products; a division of TPI Corporation.
5. Marley Electric Heating; a division of Marley Engineered Products.
6. QMark Electric Heating; a division of Marley Engineered Products.
7. Trane.

2.2 DESCRIPTION
A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
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.

2.3 CABINET
A. Front Panel: Stamped-steel louver or Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
B. Finish: Baked enamel over baked-on primer with manufacturer’s standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
C. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

2.5 FAN AND MOTOR
A. Fan: Aluminum propeller directly connected to motor.
B. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230513 “Common Motor Requirements for HVAC Equipment.”

2.6 CONTROLS
A. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.
B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.
2.7 CAPACITIES AND CHARACTERISTICS: See schedule on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall and ceiling unit heaters to comply with NFPA 90A.

B. Install wall and ceiling unit heaters level and plumb.

C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19
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. Section Includes:
   1. Copper building wire rated 600 V or less.
   2. Connectors, splices, and terminations rated 600 V and less.
B. Related Requirements:
   1. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
A. Qualification Data: For testing agency.
B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE
A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
B. 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. Alpha Wire Company.
   2. American Bare Conductor.
   3. Belden Inc.
   4. Cerro Wire LLC.
   5. General Cable Technologies Corporation.
6. Okonite Company (The).
7. Southwire Company.

C. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:
   1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. 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. 3M Electrical Products.
   2. AFC Cable Systems; a part of Atkore International.
   4. O-Z/Gedney; a brand of Emerson Industrial Automation.

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. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
D. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, 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 of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
3.7 **FIRESTOPPING**

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 **FIELD QUALITY CONTROL**

A. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each of the following visual and electrical tests:
   a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
   b. Test bolted connections for high resistance using one of the following:
      1) A low-resistance ohmmeter.
      2) Calibrated torque wrench.
      3) Thermographic survey.
   c. Inspect compression-applied connectors for correct cable match and indentation.
   d. Inspect for correct identification.
   e. Inspect cable jacket and condition.
   f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
   g. Continuity test on each conductor and cable.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
   a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519
SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE
A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION
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.
B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 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:
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch 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 wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

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. Conductor Terminations and Connections:

   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

3.2 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.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.
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.

3.3 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. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
END OF SECTION 260526
SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Conduit and cable support devices.
   2. Support for conductors in vertical conduit.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS
A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

   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; a part of Atkore International.
      b. B-line, an Eaton business.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation: A Member of the ABB Group.

   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

   3. Material for Channel, Fittings, and Accessories: Plain steel.
   4. Channel Width: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M 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.

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 where used.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A325.

6. Toggle Bolts: All-steel springhead type.


2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch 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, according to 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.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.
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. Metal conduits and fittings.
   2. Nonmetallic conduits and fittings.
   3. Metal wireways and auxiliary gutters.
   4. Surface raceways.
   5. Boxes, enclosures, and cabinets.

B. Related Requirements:
   1. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. GRC: Comply with ANSI C80.1 and UL 6.

4. EMT: Comply with ANSI C80.3 and UL 797.

5. FMC: Comply with UL 1; zinc-coated steel.

6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:
1. Comply with NEMA FB 1 and UL 514B.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Fittings, General: Listed and labeled for type of conduit, location, and use.


5. Fittings for EMT:
   a. Material: Steel.
   b. Type: Setscrew or compression.

6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

4. LFNC: Comply with UL 1660.

B. Nonmetallic Fittings:
   1. Fittings, General: Listed and labeled for type of conduit, location, and use.

   2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

   a. Fittings for LFNC: Comply with UL 514B.

3. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

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

   1. B-line, an Eaton business.

   2. Hoffman; a brand of Pentair Equipment Protection.

   3. MonoSystems, Inc.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer’s standard enamel finish.
2.4 BOXES, ENCLOSURES, AND CABINETS

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

1. Adalet.
3. EGS/Appleton Electric.
5. FSR Inc.
6. Hoffman; a brand of Pentair Equipment Protection.
8. Hubbell Incorporated; Wiring Device-Kellem.
10. Milbank Manufacturing Co.
11. MonoSystems, Inc.
12. Oldcastle Enclosure Solutions.
15. RACO; Hubbell.
16. Spring City Electrical Manufacturing Company.
17. Stahlin Non-Metallic Enclosures.
18. Thomas & Betts Corporation; A Member of the ABB Group.
19. Topaz Electric; a division of Topaz Lighting Corp.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. **Material:** Cast metal or sheet metal.
2. **Type:** Fully adjustable.
3. **Shape:** Rectangular.
4. **Listing and Labeling:** Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

J. Gangable boxes are allowed.
PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Indoors: Apply raceway products as specified below 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: GRC.

B. Minimum Raceway Size: 1/2-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

D. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 “Hangers and Supports for Electrical Systems” for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not fasten conduits onto the bottom side of a metal deck roof.

D. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
E. Complete raceway installation before starting conductor installation.

F. Arrange stub-ups so curved portions of bends are not visible above finished slab.

G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

H. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

I. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

J. Support conduit within 12 inches of enclosures to which attached.

K. Stub-Ups to Above Recessed Ceilings:
   1. Use EMT or RMC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

L. 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.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, 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.

W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a watertight connection between box and cover plate or supported equipment and box.

Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Z. Locate boxes so that cover or plate will not span different building finishes.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

CC. Set metal floor boxes level and flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install 0 sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533
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. Color and legend requirements for raceways, conductors, and warning labels and signs.
   2. Labels.
   4. Tapes and stencils.
   5. Tags.
   7. Cable ties.
   9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1.

B. Comply with NFPA 70.


D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
   1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.

C. Warning Label Colors:
   1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

E. Equipment Identification Labels:
   1. Black letters on a white field.

2.3 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.

2.4 SIGNS

A. Baked-Enamel Signs:
   1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
   2. 1/4-inch grommets in corners for mounting.

B. Metal-Backed Butyrate Signs:
   1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
   2. 1/4-inch grommets in corners for mounting.
   3. Nominal Size: 10 by 14 inches.

2.5 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
   2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F.
   5. Color: Black.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.


I. Vinyl Wraparound Labels:
   1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

J. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

K. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

L. Self-Adhesive Labels:
   1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

M. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

N. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
1. **Field-Applied, Color-Coding Conductor Tape:** Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

P. **Tape and Stencil:** Comply with requirements in painting Sections for surface preparation and paint application.

Q. **Floor Marking Tape:** Apply stripes to finished surfaces following manufacturer's written instructions.

R. **Baked-Enamel Signs:**
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

S. **Metal-Backed Butyrate Signs:**
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

T. **Laminated Acrylic or Melamine Plastic Signs:**
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

### 3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. **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 tape applied in bands.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

D. **Accessible Fittings for Raceways and Cables within Buildings:** Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."
3. "UPS."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

G. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

H. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.


K. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign.
3. Equipment to Be Labeled:

   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Enclosed switches.
   e. Enclosed circuit breakers.

END OF SECTION 260553
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. Section Includes:
      1. Indoor occupancy and vacancy sensors.
      2. Switchbox-mounted occupancy sensors.
   B. Related Requirements:
      1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings:
      1. Show installation details for the following:
         a. Occupancy sensors.
         b. Vacancy sensors.
      2. Interconnection diagrams showing field-installed wiring.
      3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.
1.6 **WARRANTY**

A. Manufacturer’s Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Faulty operation of lighting control devices.

2. Warranty Period: Two year(s) from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 **INDOOR OCCUPANCY AND VACANCY SENSORS**

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. **Sensor Switch, Inc.**

B. General Requirements for Sensors:

1. Wall or Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Dual technology.
3. Integrated power pack.
4. Hardwired connection to switch.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
   a. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.

11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.

C. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of
average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.


2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

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. **Sensor Switch, Inc.**


1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.

4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor Tag WS1:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.

2. Sensing Technology: Dual technology - PIR and microphonics.

3. Switch Type: SP, dimmable, field-selectable automatic "on," or manual "on," automatic "off."


5. Voltage: 120 V.

6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.


2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

A. Comply with NECA 1.

B. 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 systems, and partition assemblies.

C. 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.

3.3 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 “Low-Voltage Electrical Power Conductors and Cables.” Minimum conduit size is 1/2 inch.

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer’s written instructions.

D. Size conductors according to lighting control device manufacturer’s written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 “Identification for Electrical Systems.”

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
   1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner’s operations.

3.7 DEMONSTRATION

A. Train Owner’s maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923
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. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.
B. GFCI: Ground-fault circuit interrupter.
C. GFEP: Ground-fault equipment protection.
D. MCCB: Molded-case circuit breaker.
E. SPD: Surge protective device.
F. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.
   1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
   2. Include dimensions and manufacturers’ technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details.
   2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
   3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
   4. Detail bus configuration, current, and voltage ratings.
   5. Short-circuit current rating of panelboards and overcurrent protective devices.
   6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. 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. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.
B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 “Operation and Maintenance Data,” include the following:
   1. Manufacturer’s written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Keys: Two spares for each type of panelboard cabinet lock.
   2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 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.
B. Handle and prepare panelboards for installation according to NEMA PB 1.
1.10 FIELD CONDITIONS

A. Environmental Limitations:
   1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
      b. Altitude: Not exceeding 7500 feet.

1.11 WARRANTY

A. Manufacturer’s Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
   1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
   1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

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 NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush-mounted, dead-front cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   2. Height: 84 inches maximum.
   3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
   4. 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.


F. Incoming Mains:
   1. Location: Convertible between top and bottom.
   2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:
   1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
      a. Plating shall run entire length of bus.
      b. Bus shall be fully rated the entire length.
   2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
   3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

H. Conductor Connectors: Suitable for use with conductor material and sizes.
   1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
   2. Terminations shall allow use of 75 deg C rated conductors without derating.
   3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
   4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
   5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.

I. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
   1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: lugs only.
D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:


B. MCCB: Comply with UL 489, with series-connected rating to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:
   a. Inverse time-current element for low-level overloads.
   b. Instantaneous magnetic trip element for short circuits.
   c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

3. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).

4. MCCB Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Breaker handle indicates tripped status.
   c. UL listed for reverse connection without restrictive line or load ratings.
   d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
   f. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.

2.4 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.


1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

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. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:
   1. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount top of trim 90 inches above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

J. Install filler plates in unused spaces.

K. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
L. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner’s final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
   1. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

D. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
      c. Instruments and Equipment:
1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. 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.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer’s written instructions.

END OF SECTION 262416
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-grade receptacles, 125 V, 20 A.
   2. GFCI receptacles, 125 V, 20 A.
   3. Toggle switches, 120/277 V, 20 A.
   4. Occupancy sensors.
   5. Wall-box dimmers.
   6. Wall plates.
   7. Floor service fittings.

1.3 DEFINITIONS
A. GFCI: Ground-fault circuit interrupter.
B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS
A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.
PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. Comply with NEMA WD 1.

D. Devices for Owner-Furnished Equipment:
   1. Receptacles: Match plug configurations.

E. 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.

F. Wall Plate Color: For plastic covers, match device color.

G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:
   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. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
   2. Description: Two pole, three wire, and self-grounding.
   3. Configuration: NEMA WD 6, Configuration 5-20R.
   4. Standards: Comply with UL 498 and FS W-C-596.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
2. Description: Integral GFCI with “Test” and “Reset” buttons and LED indicator light. Two pole, three wire, and self-grounding.

3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.4 **TOGGLE SWITCHES, 120/277 V, 20 A**

A. Single-Pole Switches, 120/277 V, 20 A:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

2. Standards: Comply with UL 20 and FS W-S-896.

2.5 **OCCUPANCY SENSORS**

A. Wall Switch Sensor Light Switch, Dual Technology:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Sensor Switch
   b. Eaton (Arrow Hart).
   c. Hubbell Incorporated; Wiring Device-Kellems.
   d. Leviton Manufacturing Co., Inc.

2. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.

4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
5. Adjustable time delay of 30 minutes.
6. Able to be locked to Manual-On mode.

2.6 **DIMMERS**

A. Wall-Box Dimmers:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Sensor Switch
   b. Eaton (Arrow Hart).
c. **Hubbell Incorporated; Wiring Device-Kellems.**
d. **Leviton Manufacturing Co., Inc.**
e. **Lutron Electronics Co., Inc.**

2. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
3. Control: Continuously adjustable slider or toggle switch; with single-pole or three-way switching.
5. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

### 2.7 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.

### 2.8 FLOOR SERVICE FITTINGS

A. As indicated on drawings, to match existing building standard:

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. 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 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 right 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 comply with 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 devices that have been in temporary use during construction and that 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 in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by 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 to match existing building’s receptacle configuration.

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 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for 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 unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. 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.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 262726
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:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Receptacle switches.
   4. Shunt trip switches.
   5. Molded-case circuit breakers (MCCBs).
   7. Enclosures.

1.3 DEFINITIONS
A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, 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).
B. Shop Drawings: For enclosed switches and circuit breakers.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include wiring diagrams for power, signal, and control wiring.
1.5 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For qualified testing agency.
   B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE
   A. Testing Agency Qualifications: Accredited by NETA.
      1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 FIELD CONDITIONS
   A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
      2. Altitude: Not exceeding 7500 feet.

1.9 WARRANTY
   A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
      1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 GENERAL REQUIREMENTS
   A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
   B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

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

1. Eaton.
2. General Electric Company.
4. Square D

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 240-V ac.
4. 200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 NONFUSIBLE SWITCHES

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

1. Eaton.
2. General Electric Company.
4. Square D

B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 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. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).
C. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

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.
   1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
   2. Indicate method of providing temporary electric service.
   3. Do not proceed with interruption of electric service without Owner's written permission.
   4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
3.4 INSTALLATION

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.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

A. Comply with requirements in Section 260553 "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.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:
   a. Inspect physical and mechanical condition.
   b. Inspect anchorage, alignment, grounding, and clearances.
   c. Verify that the unit is clean.
   d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
   e. Verify that fuse sizes and types match the Specifications and Drawings.
   f. Verify that each fuse has adequate mechanical support and contact integrity.
   g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      1) Use a low-resistance ohmmeter.
         a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify correct phase barrier installation.
i. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816
SECTION 264313
SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

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 field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS
   A. Innominal: Nominal discharge current.
   B. MCOV: Maximum continuous operating voltage.
   C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
   D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
   E. OCPD: Overcurrent protective device.
   F. SCCR: Short-circuit current rating.
   G. SPD: Surge protective device.
   H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
      2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Innominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.
B. Sample Warranty: For manufacturer’s special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer’s Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 PANEL SUPPRESSORS

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. Current Technology Inc.
2. General Electric Company.
3. LEA International.

B. SPDs: Comply with UL 1449, Type 2.

1. Include LED indicator lights for power and protection status.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Comply with UL 1283.
E. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V for 208Y/120 V.
2. Line to Ground: 700 V for 208Y/120 V.
3. Neutral to Ground: 700 V for 208Y/120 V.
4. Line to Line: 1200 V for 208Y/120 V

F. SCCR: Equal or exceed 200 kA.

G. Nominal Rating: 20 kA.

2.3 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

2.4 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313
SECTION 265119
LED 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 the following types of LED luminaires:
   1. Recessed, linear.
   2. Strip light.
   3. Surface mount, linear.
   4. Suspended, linear.

B. Related Requirements:
   1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests IES LM-79.
   a. Manufacturers’ Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of luminaire.
B. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
C. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Diffusers and Lenses: Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
B. Provide luminaires from a single manufacturer for each luminaire type.
C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 41 to 104 deg F.
   1. Relative Humidity: Zero to 95 percent.

B. Altitude: Sea level to 7500 feet.

2.2 LUMINAIRE REQUIREMENTS

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.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels 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 characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage, and coating.
      c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

2.3 RECESSED, LINEAR.

A. Refer to luminaire schedule on drawings.

2.4 STRIP LIGHT.

A. Refer to luminaire schedule on drawings.

2.5 SURFACE MOUNT, LINEAR.

A. Refer to luminaire schedule on drawings.
2.6  SUSPENDED, LINEAR

A.  Refer to luminaire schedule on drawings.

2.7  MATERIALS

A.  Metal Parts:

1.  Free of burrs and sharp corners and edges.
2.  Sheet metal components shall be steel unless otherwise indicated.
3.  Form and support to prevent warping and sagging.

B.  Steel:

1.  ASTM A 36/A 36M for carbon structural steel.
2.  ASTM A 568/A 568M for sheet steel.

C.  Aluminum: ASTM B 209.

2.8  METAL FINISHES

A.  Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.9  LUMINAIRE SUPPORT

A.  Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B.  Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.


D.  Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E.  Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1  EXAMINATION

A.  Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B.  Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Ceiling Mount:
   a. Two 5/32-inch-diameter aircraft cable supports adjustable to 10 feet in length.
   b. Pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 10 feet in length.

3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:
1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate nor more than 6 inches 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.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

END OF SECTION 265119
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. Metal conduits and fittings.
   2. Hooks.

1.3 ACTION SUBMITTALS
A. Product data for the following:
   1. Wireways and fittings.
   2. Boxes, enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS
A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems; a part of Atkore International.
   2. Allied Tube & Conduit; a part of Atkore International.
   3. Alpha Wire.
   4. Anamet Electrical, Inc.
   5. Electri-Flex Company.
   7. Picoma Industries, Inc.
   8. Plasti-Bond.
   10. Southwire Company.
   11. Thomas & Betts Corporation: A Member of the ABB Group.
   12. Western Tube and Conduit Corporation.
C. General Requirements for Metal Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

D. EMT: Comply with ANSI C80.3 and UL 797.

E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Fittings for EMT:
      a. Material: Steel or die cast.
      b. Type: Set screw or compression.

2.2 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. MonoSystems, Inc.
   2. Panduit Corp.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

E. Galvanized steel.

F. J shape.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Indoors: Apply pathway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   4. Boxes and Enclosures: NEMA 250, Type 1

B. Minimum Pathway Size: 3/4-inch trade size for copper and aluminum cables.

C. Pathway Fittings: Compatible with pathways and suitable for use and location.
   1. EMT: Use set-screw or compression, steel fittings. Comply with NEMA FB 2.10.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Install surface pathways only where indicated on Drawings.
3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

D. Complete pathway installation before starting conductor installation.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

G. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

L. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

N. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
O. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

P. Hooks:
   1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
   2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
   3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
   4. Space hooks no more than 5 feet o.c.
   5. Provide a hook at each change in direction.

Q. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

R. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

S. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

T. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

U. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

V. Set metal floor boxes level and flush with finished floor surface.

W. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 270528
SECTION 271513

COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Category 6 twisted pair cable.
   2. Cabling identification products.
   4. Source quality control requirements for twisted pair cable.

1.3 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. FTP: Shielded twisted pair.

D. F/FTP: Overall foil screened cable with foil screened twisted pair.

E. F/UTP: Overall foil screened cable with unscreened twisted pair.

F. IDC: Insulation displacement connector.

G. LAN: Local area network.

H. Jack: Also commonly called an "outlet," it is the fixed, female connector.

I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

J. RCDD: Registered Communications Distribution Designer.

K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

M. S/FTP: Overall braid screened cable with foil screened twisted pair.

N. S/UTP: Overall braid screened cable with unscreened twisted pairs.
10. UTP: Unscreened (unshielded) twisted pair.

1.4 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as “Cabling Subsystem 1,” in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Twisted pair cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, installation supervisor, and field inspector.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Connecting Blocks: One of each type.
2. Faceplates: One of each type.
3. Jacks: Ten of each type.
4. Plugs: Ten of each type.

1.9 QUALITY ASSURANCE
A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
   1. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

1.10 DELIVERY, STORAGE, AND HANDLING
A. Test cables upon receipt at Project site.
   1. Test each pair of twisted pair cable for open and short circuits.

1.11 PROJECT CONDITIONS
A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION
A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS
A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
   1. Communications, Plenum Rated: Type CMP complying with UL 1685.
   2. Communications, Non-plenum: Type CMR complying with UL 1666.
B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. AMP NETCONNECT; a TE Connectivity Ltd. company.
3. Belden CDT Networking Division/NORDX.
4. Berk-Tek Leviton; a Nexans/Leviton alliance.
5. CommScope, Inc.
6. Draka USA.
7. General Cable; General Cable Corporation.
8. Genesis Cable Products; Honeywell International, Inc.
9. Hitachi Cable America Inc.
10. Mohawk; a division of Belden Networking, Inc.
11. Superior Essex Inc.


D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP).

F. Cable Rating: Plenum.

G. Jacket: Blue thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
3. AMP NETCONNECT; a TE Connectivity Ltd. company.
4. Belden CDT Networking Division/NORDX.
5. Berk-Tek Leviton; a Nexans/Leviton alliance.
6. CommScope, Inc.
7. Draka USA.
8. Dynacom Corporation.
9. General Cable; General Cable Corporation.
10. Genesis Cable Products; Honeywell International, Inc.
11. Hitachi Cable America Inc.
13. KRONE Incorporated.
14. Leviton Manufacturing Co., Inc.
15. Mohawk; a division of Belden Networking, Inc.
17. Panduit Corp.
18. Siemon Co. (The).
19. Superior Essex Inc.

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.

E. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.

F. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
4. Jack color shall be Red to match building standards.

G. Faceplate:

1. Four port, vertical single gang faceplates designed to mount to single gang wall boxes.
2. Eight port, vertical double gang faceplates designed to mount to double gang wall boxes.
4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
   a. Flush mounting jacks, positioning the cord at a 45-degree angle.

H. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
2.6 GROUNDING
A. Comply with requirements in Section 270526 “Grounding and Bonding for Communications Systems” for grounding conductors and connectors.
B. Comply with TIA-607-B.

2.7 SOURCE QUALITY CONTROL
A. Factory test cables on reels according to TIA-568-C.1.
B. Factory test twisted pair cables according to TIA-568-C.2.
C. Cable will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for raceways and boxes specified in Section 270528 “Pathways for Communications Systems.”
B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS
A. Comply with Section 270528 “Pathways for Communications Systems.”
B. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES
A. Comply with NECA 1 and NECA/BICSI 568.
B. General Requirements for Cabling:
   1. Connector pinout configuration shall be TIA-568A to match building standards.
2. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
4. Install 110-style IDC termination hardware unless otherwise indicated.
5. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
6. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot-long service loop on each end of cable.

C. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:
1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."
B. Comply with TIA-569-D, Annex A, "Firestopping."

3.5 GROUNDING

A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
B. Comply with TIA-607-B and NECA/BICSI-607.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Coordinate with owner for labeling standards and requirements

B. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

C. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

   1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

   1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
   2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
   3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

   a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

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 271513
SECTION 31 6329 - DRILLED CONCRETE PIERS AND SHAFTS

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Machine drilled shaft.

1.02 RELATED REQUIREMENTS
   A. Section 03 3000 - Cast-in-Place Concrete: Requirements for concrete and reinforcement.

1.03 REFERENCE STANDARDS

PART 2 PRODUCTS
2.01 MATERIALS
   A. Concrete Materials and Mix: Specified in Section 03 3000.
   B. Reinforcement: Specified in Section 03 3000.
   C. Equipment: Appropriate for dewatering excavated shaft.

PART 3 EXECUTION
3.01 INSTALLATION
   A. Construct piers in accordance with ACI 336.1.
   B. Drill vertical pier shafts to diameters and depths indicated.
   C. Clean shaft and bottom of loose material. Provide temporary means and methods, as required, to remove all water from soil borings as needed, or until directed by the Geotechnical Engineer.
   D. Allow inspection of shaft prior to placement of reinforcement and concrete.
   E. Place concrete in single pour, in accordance with Section 03 3000 with equipment designed for vertical placement of concrete.
   F. Extend reinforcement for connection of caps.
   G. Set tops of piers to elevations indicated.

3.02 TOLERANCES
   A. Install piers with maximum variation from location, plumbness, bottom area, diameter, and anchorage locations as specified in ACI 336.1.

END OF SECTION