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# Elmira High School Fern Ridge School District Elmira, Oregon

Bid & Permit Set DLR Group Project No. 74-13107-40

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#### PART 1 - GENERAL

# 1.1 SUBMISSION OF BIDS AND BID OPENING

- A. In accordance with ORS 279C.365, bids will be received by Fern Ridge School District 28-J, and will be opened and read at the time and place set forth in the Bid Document. Bidders, or their representative, and other interested persons may be present at the opening of bids.
- B. The District will accept bids in person at the district office prior to the bid closing date and time.
- C. The Bidder shall assume full responsibility for timely submission of bids.

#### 1.2 BIDDING DOCUMENTS

- A. Bidding Documents are those posted by the district, including attachments and any Addenda issued prior to receipt of bids. All requirements and obligations of the Bidding Documents are hereby incorporated by reference into the Contract Documents and are binding on the Successful Bidder upon award of the Contract.
- B. Bona fide bidders may access Bidding Documents by requesting them through the business office of the Fern Ridge School District
- C. Bidders shall use complete sets of Bidding Documents in preparing Bids. The Owner, Project Manager, and the A/E assume no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- D. The Owner in making copies of the Bidding Documents available on the above terms does so only for the purpose of obtaining Bids on the Work and does not confer a license or grant for any other use.
- E. When boring data (geological) is provided by Bidding Documents, the Contractor shall assume responsibility for any conclusions it may draw from such data. It may employ its own consultants to analyze available information and to conduct additional tests and examinations of site conditions and shall be responsible for any conclusions drawn from such information, tests and examinations. The Owner does not warrant and specifically disclaims any responsibility for the interpretation of any such data or information.

### 1.3 DEFINITIONS

- A. THE BID
  - 1. A Bid is a complete and properly signed competitive offer to do the work for the sums stipulated therein, submitted in accordance with the Bidding Documents.
- B. BASE BID:

1. The Base Bid is the sum stated in the Bid for which the Bidder offers to perform all the Work shown and described in the Bidding Documents as a lump sum bid, to which Work may be added or deducted for sums stated in Alternate Bids, if any.

# C. ALTERNATES:

1. An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents is accepted by the Owner. Any or all Alternates may be accepted or rejected in any order.

# 1.4 QUALIFICATIONS OF BIDDERS

- A. Only Bidders that have been pre-qualified by RFQ 1.14.16.1 are permitted to submit bids for this work. All other bids will be disqualified
- B. List of Qualified Bidders is shown in section 004005 of the specifications or can be requested from the business office of the Fern Ridge School District.
- 1.5 BIDDER'S REPRESENTATIONS: Each Bidder by submitting its Bid represents that:
  - A. I/We have read and understand the Bidding Documents and its Bid is made in accordance therewith; and Bidder agrees to be bound by the terms and requirements set forth in the Bidding and Contract Documents; B. I/We have visited the site, have familiarized ourselves with the local conditions under which the Work is to be performed in accordance with Paragraph 10 herein, and have correlated our observations with the requirements of the proposed Contract Documents;
  - B. Bid is based upon the materials, systems and equipment required by the Bidding Documents without exception; and
  - C. I/We have the capability, in all respects, and the moral and business integrity, reliability, technical ability, financial resources, plant, management, superintendence, equipment and materials which will assure effective and efficient good faith performance in full compliance with the Contract Documents and with any and all schedules and completion dates required by the Owner. The Bidder acknowledges and represents that it has made allowances for normal inclement weather indigenous to the Project Site, in estimating, planning and scheduling of the Work. The Bidder further acknowledges that the Contract Documents are, in its opinion, appropriate and adequate for completing this project and for the construction of sound and suitable work. The Bidder hereby certifies that the Work shall be completed, in place, in full accordance with the Contract Documents, within the time limits specified.

### 1.6 PREPARATION AND SUBMITTAL OF BID FORM

- A. Bids shall be submitted using the online system, and shall be complete in every respect. The total Bid amount shall be entered in written words and figures in the space provided. Amounts for alternates and unit prices should be entered in the spaces provided.
- B. For lump sum Bids, in the event of a discrepancy between the Bid amount in writing and that in figures, the written value shall govern.

- C. Bids shall not contain any restatement or qualifications of work to be done and alternate bids will not be considered unless called for. No oral, telegraphic or telephonic bids or modifications will be considered.
- D. Bids must be submitted by the closing date and time shown on the bidding documents.

# 1.7 BID SECURITY

A. If requested, each Bid must be accompanied by a Bidder's Bond on the Form of Bid Bond provided herein or on a similar form which in every respect materially complies with said Form of Bid Bond, in the amount of ten percent (10%) of its Bid. For purposes of this provision, the amount of the Bid shall be the Base Bid. The Bidder's Bond shall be issued by a Surety company licensed to conduct business in the State of Oregon and be acceptable to the Owner. The Surety signing the Bidder's Bond shall be registered with the Oregon State Insurance Commissioner, and the Surety's name shall appear in the current Authorized Insurance Company list in the State of Oregon published by the office of the Insurance Commissioner. Each Surety's name must also appear on the United States Treasury Department's list of authorized sureties, circular 570, as amended.

Bidders are to attach a copy of the bid security to their response. Bidders are required to provide contact information for the bonding company so the District can verify the bond is authentic. Failure to provide valid contact information may result in rejection of the bid.

- B. Said Bid Security is given as a guarantee that the Bidder will enter into a Contract if awarded the Work and, in the case of refusal or failure to so enter into said Contract, the Bid Security shall be declared forfeited to the Owner, in accordance with ORS 279C.385. Such Bid Security shall be returned to all but the three (3) lowest Bidders after the opening of the Bids and the remaining Bid Security will be returned after the Owner and the successful Bidder have executed the Contract. If no Contract has been awarded or the Bidder has not been notified of the acceptance of its Bid, within sixty (60) days of the Bid opening, the Bidder may withdraw its Bid and request the return of its Bid Security. If, at the Owner's or Project Manager's request, the Bidder agrees to extend and maintain its Bid beyond the specified sixty (60) days, its Bid Security will not be returned until after the Owner and the Successful Bidder have executed the Contract.
- C. The successful Bidder, upon their failure or refusal to execute the Contract within ten (10) days after it has received Notice of Acceptance of its Bid, shall forfeit to the Owner the Bid Security deposited with its Bid, as liquidated damages for such failure or refusal.

### 1.8 INSURANCE BINDER

A. The successful bidder is required to provide a certificate of insurance within five days of bid award, for the coverage specified elsewhere in the bidding documents.

### 1.9 UNIT PRICES

- A. The Bidder shall include in the spaces provided on the Bid Form a Bid for each unit price.
- B. The Owner may accept or reject any or all of these unit prices and include them in the Contract.
- C. The Owner is not obligated to use these unit prices and may require the Contractor to provide complete breakdown of costs listed therein.

# 1.10 SITE CONDITIONS AND CONDITIONS OF THE WORK

- A. Each Bidder must acquaint themselves thoroughly as to the character and nature of the Work to be done and the conditions under which the work will be performed. Each Bidder furthermore must make a careful examination of the site of the Work and inform themselves fully as to the difficulties to be encountered in the performance of the Work, the facilities for delivering, storing and placing materials and equipment, existing and available services and utilities, environmental and access constraints, permit requirements and other conditions relating to construction and labor.
- B. The Successful Bidder, assumes all risk as to the nature and behavior of the soil or subsurface conditions which underlie the Work or is adjacent thereto, or difficulties that may be due to any unfavorable conditions that may be encountered in the Work, whether apparent on surface inspection or disclosed after construction begins.
- C. No plea of ignorance of conditions that exist or may hereafter exist on the site of the Work, or difficulties that may be encountered in the execution of the Work, as a result of failures to make necessary investigations and examinations, will be accepted as an excuse for any failure or omission on the part of the Successful Bidder to fulfill in every detail all the requirements of the Contract Documents and to complete the Work for the consideration set forth therein, or as a basis for any claim whatsoever.
- D. Insofar as possible, the Successful Bidder, in carrying out its work, must employ such methods or means as will not cause interruption of or interference with the Work of the Owner, the Project Manager or any separate Contractor.
- E. The Contract includes excavation on an unclassified basis. The cost of all excavation and backfill required under this Contract is a part of the Base Bid. No distinction will be made insofar as payment is concerned between earth and rock.

### 1.11 BIDDER'S QUESTIONS, ADDENDA, AND BID INTERPRETATIONS

- A. Bidder's and Sub-Bidders shall promptly notify the Owner through the A/E of any ambiguity, inconsistency, or error, which they may discover upon examination of the Bidding and Contract Documents or of the site and local conditions. No interpretation of the meaning of the drawings, specifications or other Contract Documents will be made to any Bidder orally.
- B. Every request for such interpretation shall be in writing addressed to the Project Manager, utilizing Section 00210 form, and to be given consideration must be received at least ten (10) days prior to the date fixed for the opening of the Bids, or two days after the mandatory pre-bid, whichever occurs last.
- C. Any and all such interpretations and any supplemental instruction will be in the form of written addenda to the Bidding Documents which, if issued, will be posted on the online bidding system not later than three (3) calendar days prior to the date fixed for the opening of the Bids. Neither the Project Manager nor the Owner will be responsible for any other explanations or interpretations of the proposed documents. Failure of any Bidder to receive any such addendum or interpretation shall not relieve the Bidder from any obligation under its Bid as submitted. All addenda so issued shall become a part of the Contract Documents.

D. If the Bidder (or any person bidding to Bidder and/or subsequently in contract with the Bidder, relating to the subject project) knows, or should have known, that an ambiguity, discrepancy, error, omission or conflicting statement exists in the Bidding or Contract Documents, said Bidder has an obligation to seek a clarification thereof from the A/E prior to the Bid. The Owner will welcome such a clarification request, and, if deemed necessary by the Owner, the Project Manager or A/E, the Purchasing Department will issue a written addendum clarifying the matter in question.

# 1.12 SECURITY FOR FAITHFUL PERFORMANCE

A. If requested, the Successful Bidder shall furnish a Performance and Payment Bond in an amount equal to one hundred percent (100%) of the Contract sum, as security for the faithful performance of this Contract and as security for the payment of all persons performing labor and furnishing materials under this Contract. The Performance and Payment Bond shall be acceptable to the Owner, in accordance with State law and shall be delivered to the Owner not later than the date of execution of the Contract. The Surety signing the Bond shall be registered with the Oregon State Insurance Commissioner, and the Surety's name shall appear in the current Authorized Insurance Company list in the State of Oregon published by the office of the Insurance Commissioner. The Surety's name must also appear on the United States Treasury Department's list of authorized sureties, circular 570, as amended. No Work shall commence at the project site until approved Bonds are received by the Owner. Both bonds shall be in compliance with ORS Sections 279C.380, 279C.625 and 701.430.

### 1.13 TIME FOR COMPLETION

The time for completion of this Contract shall be as listed on the Construction Milestone Schedule in section 004010 of the specifications and as fixed in the Owner-Contractor Agreement.

#### 1.14 LOCATION OF THE WORK

The site of the proposed work is on Owner owned property, public streets, easements and/or other right-of-ways, as shown on the drawings.

### 1.15 LIABILITY INSURANCE AND WORKER'S COMPENSATION

The Successful Bidder will be required to carry public liability and worker's compensation and other insurance in the amounts and under the terms stipulated under the General Conditions. No Work shall commence at the project site until approved Certificates are received by the Owner. Limits of liability and general aggregate coverage limits shall apply on a per project basis.

#### 1.16 BIDDERS REFERRED TO LAWS

A. The attention of the Bidders is called to the provisions of all Local, State and Federal laws, regulations, ordinances and resolutions applicable to the work, as well as laws, regulations, ordinances, resolutions and permits relating to obstructing streets, maintaining signals, storing and handling of explosives, preserving safety or affecting the Bidder, or its employees or its work hereunder in its relation to the Owner or any other person. The Bidder shall obey all such laws, regulations, ordinances, permits or resolutions applicable to the Work or controlling or limiting Contractors while engaged in the prosecution of the Work under this Contract.

B. The provisions of this Contract shall be interpreted in accordance with the laws of the State of Oregon and in accordance with the laws, ordinances, regulations, permits and resolutions of Marion County.

# 1.17 TAXES

Contractor shall include in its Bid and pay for all applicable taxes. Refer to General Conditions regarding further discussion. Certification of Compliance with Oregon tax laws is required to be submitted prior to commencement of work.

### 1.18 RIGHT TO REJECT BIDS

The Owner expressly reserves the right to reject any or all Bids, to waive any informalities or irregularities in the Bids received, and to accept that Bid which in its judgment, best serves the interest of the Owner.

### 1.19 MODIFICATION AND WITHDRAWAL OF BID

- A. A Bidder may withdraw its Bid from consideration if the price Bid was substantially lower than the other Bids due solely to a mistake therein, provided: (1) the Bid was submitted in good faith; and (2) the mistake was a clerical mistake as opposed to a judgment mistake, and; (3) the mistake was actually due to an unintentional arithmetic error or an unintentional omission of a quantity of work, labor or material made directly in the compilation of a Bid, which unintentional error or omission can be clearly shown by objective evidence drawn from inspection of original work papers, documents and materials used in the preparation of the Bid sought to be withdrawn. The Bidder shall give notice in writing of its claim of right to withdraw its Bid within two (2) business days after the conclusion of the Bid opening procedure.
- B. Prior to the time and date designated for the receipt of Bids, any Bid submitted may be retracted by the Bidder.
- C. Withdrawn Bids may be resubmitted up to the time designated for the receipt of the Bids provided that they are then fully in conformance with these Instructions to Bidders.
- D. Bid security, if any is required, shall be in an amount sufficient for the Bid as modified or resubmitted.

### 1.20 DETAILED BID BREAKDOWN

- A. Upon notification from the Owner or the Project Manager to the Bidder that submitted the apparent lowest responsive Bid, the Bidder shall, within forty-eight (48) hours, provide a detailed breakdown of its Bid in a form acceptable to the Owner or Project Manager.
- B. The breakdown may be used by the Owner to verify accounting requirements, and to determine whether the Bidder has grossly misjudged the requirements of any area.
- C. The Bidder's failure to provide the requested detailed breakdown in the specified time may result in rejection of the Bid at the sole discretion of the Owner.

# 1.21 AWARD OF CONTRACT

The Contract will be awarded to the lowest responsive and responsible Bidder whose Bid is considered to be in the best interest of the Owner. After the Owner determines that a contract is to be awarded, it will award the contract to the lowest responsible bidder. The "lowest responsible bidder" will be the lowest bidder who has substantially complied with all bidding requirements and procedures and who has not been disqualified by the Owner under ORS 279C.375. In determining the lowest responsible bidder, the Owner shall add a percentage increase of the bid of nonresident bidder as required by ORS 279A.120.

- A. The Lowest Bidder is determined by the aggregate amount of the Base Bid, plus any Alternates selected by the Owner or Project Manager.
- B. A Responsive Bidder shall mean a Bidder who has submitted a Bid, which conforms, in all material respects, to the Bidding Documents.
- C. A Responsible Bidder shall mean a Bidder who has the capability, in all respects, to perform fully the Contract requirements and the moral and business integrity and reliability, which will assure good faith performance. In determining responsibility, the following criteria will be considered:
  - 1. The ability, capacity and skill of the Bidder to perform the Contract or provide the services required;
  - 2. Whether the Bidder can perform the Contract or provide the service promptly, or within the time specified, without delay or interference;
  - 3. The character, integrity, reputation, judgment, experience and efficiency of the Bidder;
  - 4. The quality of performance of previous contracts or services. For example, the following information will be considered:
    - a. The administrative and consultant cost overruns incurred by Owners on previous contracts with Bidder,
    - b. The Bidder's compliance record with Contract General Conditions on other projects,
    - c. The submittal by the Bidder of excessive and/or unsubstantiated extra costs proposals and claims on other projects,
    - d. The Bidders record for completion of the work within the Contract time or within Contract milestones and Bidders compliance with scheduling and coordination requirements on other projects,
    - e. The Bidder's demonstrated cooperation with the Owner, the Project Manager, or the A/E and other Contractors on previous contracts,
    - f. Whether the work performed and materials furnished on previous contracts were in accordance with the Contract Documents;

- 5. The previous and existing compliance by the Bidder with laws, regulations, resolutions and ordinances relating to contracts or services;
- 6. The sufficiency of the financial resources and ability of the Bidder to perform the Contract or provide the services;
- 7. The quality, availability and adaptability of the goods or services to the particular use required;
- 8. The ability of the Bidder to provide future maintenance and service for the warranty period of the Contract;
- 9. Whether the Bidder is or has been in arrears to the Owner on debt or contract or is or has been a defaulter on surety to the Owner;
- 10. Such other information as may be secured by the Owner or the Project Manager having a bearing on the decision to award the Contract, to include, but not limited to:
  - a. The ability, experience and commitment of the Bidder to properly and reasonably plan, schedule, coordinate and execute the Work,
  - b. Whether the Bidder has ever been debarred from bidding or found ineligible for bidding on any other projects.
- D. The purpose of the above is to enable the Owner or the Project Manager in its opinion, to select the Bid that is in the best interest of the Owner. The ability of the low Bidder to provide the required bonds will not of itself demonstrate responsibility of the Bidder.
- E. The Owner reserves the right to require from the Bidder: (1) submission of references, within seventy-two (72) hours, to include a listing of previous and current projects and (2) financial statements indicating current financial status, prepared in accordance with generally accepted accounting principles, by a CPA licensed to do business in the State of Oregon.
- F. The Owner reserves the right to defer award of this Contract for a period of sixty (60) days after the due date of the Bids. During this period of time, the Bidder shall guarantee the prices quoted in its Bid.

### 1.22 BID PROTEST

Any actual bidder who is adversely affected or aggrieved by the Owner's notice of award of the contract to another bidder on the same solicitation shall have seven (7) calendar days after notice of award to submit to the Owner a written protest of the notice of award. The written protest shall specify the grounds upon which the protest is based. In order to be an adversely affected or aggrieved with the right to submit a written protest, a bidder must itself claim to be eligible for award of the contract as the lowest responsible bidder and must be next in line for award, i.e., the protestor must claim that all lower bidders are ineligible for award because they are non-responsive or non-responsible. The Owner will not entertain a protest submitted after the time period established in this provision. The Owner's designee shall have the authority to settle or resolve the written protest. If the protest is not settled or resolved by mutual agreement, the Owner's designee shall promptly issue a written decision on the protest.

# **1.23 SUBCONTRACTORS**

- A. All Subcontractors proposed for the Work must be acceptable to the Owner.
- B. Contractor shall comply with ORS 279C.580, a copy of which is hereto attached under Section 00667.
- C. The Owner reserves the right to request the proposed Subcontractors to complete Bidder Qualification Forms and/or current financial statements prepared by a Certified Public Accountant. These forms will be similar to those required of a Bidder under Instruction to Bidders.
- D. In accordance with ORS 279A.110
  - (1) A bidder or proposer who competes for or is awarded a public contract may not discriminate against a subcontractor in the awarding of a subcontract because the subcontractor is a minority, women or emerging small business enterprise certified under ORS 200.055.
  - (2) The public contracting agency may debar or disqualify under ORS 279C.440 any person as a bidder on a public contract if the agency finds that the person has violated subsection (1) of this section in a contract between the person and the agency.
  - (3) If the person desires to appeal the disqualification, the appeal procedure shall be subject to ORS 279C.445 to 450.

# 1.24 PREVAILING WAGE RATES

- A. If applicable, labor required for the construction of this project is subject to the prevailing wage rates as provided in the General Requirements.
- B. Contractors working on public works projects must obtain and file with the Construction Contractors Board (CCB) a public works bond with a corporate surety authorized to do business in Oregon for the amount of \$30,000 before starting work on a contract or subcontract for a public works project, unless exempt. (Mandated by SB477 2005)

### 1.25 PRE-BID CONFERENCE

A. When scheduled, a Pre-Bid Conference will be conducted by the Project Manager in conjunction with the A/E at the time indicated in the Advertisement for Bids to afford Bidders the opportunity to question the Owner, the Project Manager, and the A/E.

The meeting will be held at the location identified in the Bidding Documents. Sign-in will begin 15 minutes prior to start of meeting. Bidders must be signing in by no later than 10 minutes after meeting start time. Any bidders not signing in by that time may be deemed late and not eligible to submit a bid. The District reserves the right to consider unusual or extenuating circumstances

#### 1.26 INSPECTION AND LABORATORY TESTING

A. Inspection and Laboratory Testing shall be provided as called for in the General Requirements and Technical Specifications by a Testing Consultant to be retained by the Owner.

#### 1.27 PROGRESS PAYMENTS

- A. Monthly progress payments will generally be made to the Contractor by the Owner within thirty (30) days after approval of the Certificate of Payment by the Owner.
- B. The Owner will retain funds from progress payments as described in General Conditions and in accordance with ORS 279C.550 through 279C.570.

#### 1.28 SUBSTITUTIONS

The attention of potential bidders and other interested parties is called to the conditions set forth in Division 1, Section 01600, "Material and Equipment", regarding approval and product options for substitutions. All requests for substitutions must be submitted on the form provided in the bidding documents.

#### 1.29 DRUG TESTING PROGRAM FOR PUBLIC IMPROVEMENT CONTRACTS

Pursuant to ORS 279C.505, District's performance under this contract is conditioned upon the Contractor's compliance with the following Contractor representations and warranties.

Contractor represents and warrants the following:

- A. That Contractor has at the time of the execution of this contract and shall maintain during the term of this contract, an employee drug testing program for its employees that includes, at a minimum, the following:
  - (1) A written employee drug-testing policy,
  - (2) Required drug testing for all new Subject Employees or alternatively, required testing of all Subject Employees every six (6) months on a random selection basis,
  - (3) Required testing of a Subject Employee when the Contractor has reasonable cause to believe the Subject Employee is under the influence of drugs, and
  - (4) Required testing of a Subject Employee when the Subject employee is involved in:
    - (i) an incident causing an injury requiring treatment by a physician, or
    - (ii) an incident resulting in damage to property or equipment.

A drug-testing program that meets the above requirements will be deemed a "Qualifying Employee Drug-testing Program." For the purposes of this section, an employee is a "Subject Employee" only if that employee will be working on the

Project job site; and

B. That Contractor shall require each subcontractor providing labor for the Project to:

- (1) Demonstrate to the Contractor that it has a Qualifying Employee Drug- testing Program for the subcontractor's Subject Employees, and represent and warrant to the Contractor that the Qualifying Employee Drug-testing Program is in place at the time of subcontract execution and will continue in full force and effect for the duration of the subcontract, or
- (2) Require the subcontractor's Subject Employees participate in the Contractor's Qualifying Employee Drug-testing Program for the duration of the subcontract.

#### 1.30 BACKGROUND CHECKS

A. Contact with Students. "Unsupervised contact" with students means contact that provides the person opportunity and probability for personal communication or touch with students when not under direct District supervision. As required by ORS 326.603, Contractor shall ensure that Contractor, any subcontractors, and their officers, employees. and agents will have no direct, unsupervised contact with students while on District property. Contractor shall work with District to ensure compliance with this requirement. If (1) the work site is not a "closed site" as described below, and (2) Contractor is unable to ensure through a security plan that none of its officers, employees, or agents or those of its subcontractors will have direct, unsupervised contact with students in a particular circumstance or circumstances, then Contractor shall notify District before beginning any Work that could result in such contact. Contractor authorizes District to obtain information about Contractor and its history and to conduct a criminal background check, including fingerprinting, of any Contractor officers, employees, or agents who may have unsupervised contact with students. Contractor shall cause its employees and/or subcontractors, if any, to authorize District to conduct these background checks. Contractor shall pay all fees assessed by Oregon Department of Education for processing the background check. District may deduct the cost of such fees from a progress or final payment to Contractor under this Contract, unless Contractor elects to pay such fees directly. All Contractors and their employees whether full time or part time working at closed sites must undergo a criminal history verification for disqualifying convictions per ORS 342.143 Criminal history verification checks will be conducted at the Contractor's expense, by the Fern Ridge School District or an approved third party vendor.

Closed Sites. At district sites that are closed for construction or other purposes, Contractor fingerprinting is not required. However, all Contractors and their employees whether full time or part time working at closed sites must undergo a criminal history verification for disqualifying convictions per ORS 342.143 Criminal history verification checks will be conducted at the Contractor's expense by the Fern Ridge School District or an approved third party vendor. Prior to entry of a Contractor's employees onto a jobsite, the Contractor shall provide a list of its employees who have successfully undergone the criminal history verification check.

### END OF SECTION 002113

SECTION 004000 – AN INVITATION TO BID

# FERN RIDGE SCHOOL DISTRICT 28J

88834 Territorial Rd Elmira, OR 97437

# INVITATION TO BID

Elmira High School Auxiliary Gymnasium and Locker Room Renovations

Bids Due: Tuesday, March 29th, 2016

Time Due: 2:00 pm, PST

#### **Business Manager:**

Quanah Bennett Phone: (541) 935-2253 Email: gbennett@fernridge.k12.or.us

#### **INVITATION TO BID**

The FERN RIDGE SCHOOL DISTRICT 28J (District) invites pre-qualified Respondents to submit bids to construct the auxiliary gymnasium and locker room renovations at Elmira High School. Bids are due by 2:00 pm, PST, on Tuesday, March 29<sup>th</sup>, 2016. The District reserves the right to reject any or all bids; this invitation to bid does not obligate the District to accept or contract for any expressed or implied services. The successful bidder must comply with the District's equal opportunity requirements.

#### **SCOPE OF WORK**

The Work is summarized as follows:

Demolition of a portion of the existing entrance canopy, covered walkway at courtyard, and some associated site work and addition of new auxiliary gym, lobby space with concessions and toilets, and renovations to existing girls' locker rooms, storage, and toilets. The work includes an alternate, which addresses an expanded lobby.

### **RELATED REQUIREMENTS**

Section 004005 "List of Qualified Bidders". Section 004010 "Construction Milestone Schedule". Section 004020 "Alternates".

### WALKTHROUGH

There will be a pre-bid walkthrough to give the pre-qualified bidders a better understanding of the project. The walkthrough will be at 3:00 pm on Wednesday March 16<sup>th</sup>, 2016, at the District Office at 88834 Territorial Road, Elmira, OR, 97437. The meeting will begin in the conference room at the District Office followed by a walkthrough of the high school. Alternate walkthroughs can be scheduled prior to the bid. Please contact Emil Hameed at 503-539-2245 or <u>emilh@cornerstonemgi.com</u> to schedule times.

#### SUBMISSION REQUIREMENTS

To qualify as a responsive submission, the submittal must be fully completed. An authorized representative must sign the Statement of Assurances in ink. Submittals can be mailed or hand delivered to Fern Ridge School District 28J, 88834 Territorial Rd, Elmira, OR 97437. Responses must be received by 2 pm on March 29<sup>th</sup>, 2016.

#### **BID OPENING**

Bids will be accepted until 2:00 pm PST on Tuesday, March 29<sup>th</sup>, 2016. Bids must be received on or before that time; postmarks or other proof of dispatch ARE NOT acceptable as delivery by the time set. Bids will be opened at the district office after the bid time closes. Pursuant to ORS 279C.370, for contracts with an estimated value of more than \$100,000, contractors will have until 4:00pm PST on March 29th, 2016 to submit disclosure of the first tier subcontractors, if any.

#### **BID FORM**

Each bidder must identify whether the bidder is or is not a resident bidder, as defined in ORS 279A.120. No bidder or subcontractor can be considered if the bidder or a subcontractor is on the current list of contractors ineligible to receive public works contracts as published by the Commissioner of the Bureau of Labor and Industries (BOLI).

No offer will be considered by the District unless the offeror has acknowledged that Contractor agrees to be bound by and will comply with the provisions of ORS 279C.838, 279C. The District shall pay the required prevailing wage fee to BOLI.

No offer will be considered by the District unless the offeror is registered with the Oregon Construction Contract Board. The Contractor need not be licensed for asbestos abatement. Every Contractor and subcontractor must have a public works bond filed with the Commissioner of the Bureau of Labor and Industries before starting work, unless exempt.

Each bidder must certify that there has been no discrimination against minority, women or emerging small business enterprises in obtaining any subcontracts. Bidders are encouraged to include minority, women or emerging small business enterprises as subcontractors.

*Instructions for First-Tier Subcontractor Disclosure:* Bidders are required to disclose information about certain first-tier subcontractors when the contact value for a public Improvement is greater than \$100,000. Specifically, when the contract amount of a first-tier subcontractor furnishing labor or labor and materials would be greater than or equal to:

- i. Five percent of the project Bid, but at least \$15,000; or
- ii. \$350,000 regardless of the percentage.

The Bidder must disclose the following information about that subcontract either in its Bid submission, or within two hours after Bid Closing:

- A. Subcontractor's name;
- B. Category of work that the subcontractor would be performing, and
- C. Dollar value of the subcontract.

If the Bidder will not be using any subcontractors that are subject to the above disclosure requirements, the Bidder is required to indicate "NONE" on the accompanying form.

THE DISTRICT MUST REJECT A BID IF THE BIDDER FAILS TO SUBMIT THE DISCLOSURE FORM WITH THIS INFORMATION BY THE STATED DEADLINE (OAR 137-049-0360)

#### SPECIFICATIONS AND ADDENDA

Any addenda will be posted at the same location as the bid document, labeled as "ADDENDUM" and numbered in order of issuance. Requests for notification can be made by sending an email to the Business Manager.

#### **SELECTION PROCESS**

Anticipated selection process:

- Bids will be reviewed for completeness after opening. Incomplete bids will be set aside.
- □ Completeness determinations will be made within 24 hours of bid closure.
- □ Notice of intent to award will be issued within 24 hours of bid openings
- □ Any protest of this solicitation must be submitted within seven days of the issuance of the solicitation. Any protest of the intent to award must be filed within two business days of the issuance of the notice of intent.

Any protest must be filed in writing with the District. The protest must indicate the nature of the objection, and must be sufficiently detailed for a neutral observer to discern the specific matter being objected to. Protests will be reviewed by the District and, if not resolved, will be submitted to the District's Board of Directors. The decision of the Board of Directors is final.

The District will select the lowest cost Responsible Bidder. To be considered a Responsible Bidder, a bidder must submit a bid that demonstrates Bidder's qualifications to perform the work in terms of staff qualifications, past related experience, and references. Bidders who cannot demonstrate satisfactory performance of at least two similar projects in similar circumstances will not be considered qualified.

The selected Respondents and all others who submitted Bids will be notified of the District's selection.

#### Additional Notes:

In evaluating the bids and selecting a Respondent, the District reserves the following rights:

- □ To reject any bid not in compliance with the bid document or applicable procedures and requirements, and may reject for good cause any or all bids when it is in the public interest to do so;
- □ To issue subsequent requests for bids, if desired;
- □ Not to award a contract and cancel the process;
- □ To waive any minor irregularities or informalities in any bid;
- □ To negotiate with any Respondent to further amend, modify, refine, or delineate its bid, and the contract price as it is affected by such negotiation of scope of work, and specific contract terms;
- □ This Invitation to Bid does not constitute an offer to contract.
- □ There is no expressed or implied obligation for the District to reimburse responding bidders for any expenses incurred in preparing, submitting, or presenting Bids in response to this request.

# ATTACHMENT A INVITATION TO BID RESPONSE

#### **Respondent Information**

Bidder Name:
Office Address:
Office Phone Number:
Contact Name/Title:
Contact Email:
Contact Phone and Email:
Construction Contractor's Board License #:

- 1. Please include a signed Statement of Assurances (Attachment B).
- 2. Please include a pricing proposal, in the form of completion of a signed Attachment C.
- 3. Please include a completed subcontractor disclosure form, Attachment D. You must enter "NONE" if there are no subcontractors that need to be disclosed.

#### Summary:

Please complete and submit information requested in Attachment A, B, C and D.

# ATTACHMENT B STATEMENT OF ASSURANCES

- 1. The undersigned attests that he/she has the authority and/or responsibility to represent the organization submitting this Bid in all phases of the Invitation to Bid process and in this Statement of Assurances. The undersigned understands that any false or substantially incorrect statement in the Invitation to Bid may disqualify this Bid from further consideration or be cause for termination of any future Contract.
- 2. Respondent understands that this Invitation to bid is considered an integral part of the Request for Bid, and terms shall be binding on the Respondents. Failure of the successful bidder to accept these obligations in a Contract as authorized by the Statement of Assurances may result in cancellation of an award.
- 3. Respondent understands that in responding to this Invitation to Bid, Respondent certifies that the organization he/she represents is in compliance with all Oregon Tax laws described in ORS 305.380(4) and agrees to comply with all applicable federal, state, and local laws, regulations and requirements related to the Invitation to Bid and performance of any resulting Contract, including but not limited to those referenced in this Invitation.
- 4. Respondent certifies that Respondent can meet the insurance requirements check marked in Appendix D of the proposed Contract (Insurance Coverage Required) and that Respondent understands that such coverage must be kept active during the entire term of the Contract, if selected. The Respondent is a (check one) \_\_\_\_\_ resident Respondent or \_\_\_\_\_ nonresident Respondent of the State of Oregon as defined in ORS 279A.120.
- 5. Respondent, if selected as Contractor, agrees to be bound by and will comply with the provisions of ORS 279C.838 and 279C.840.
- 6. The Representative's Signature below is certification that there has been no discrimination against minority, women or emerging small business enterprises in obtaining any subcontracts.

I, the undersigned, have read and thoroughly understand the Invitation to Bid instructions and all other conditions of Invitation to Bid issued by the FERN RIDGE SCHOOL DISTRICT 28J and agree to abide by and fulfill the requirements thereof if awarded the Contract as a result of this Invitation to Bid.

Respondent Name:	
Authorized Representative's Signature:	
Type or Print Name & Title:	
Date:	

# ATTACHMENT C PRICING PROPOSAL

1. The undersigned (check one of the following and insert information requested), NAME

of I	FIRM:
	A corporation organized and existing under the laws of the State of
	; or

A partnership registered under the laws of the State of \_\_\_\_\_; or

An individual proprietorship doing business under an assumed business name registered under the laws of the State of \_\_\_\_\_\_.

after having carefully examined the bidding documents and **addenda numbered** \_\_\_\_\_ **through** \_\_\_\_\_ inclusive, as well as the work site and conditions affecting the work, hereby proposes and agrees to furnish all labor, materials, and all other work, required by and in strict conformance with the above documents, necessary to complete the project for the stipulated sum of:

#### Base Bid:

### A. ELMIRA HIGH SCHOOL AUXILIARY GYMNASIUM AND LOCKER RENOVATIONS

TOTAL	. (Figure	s):	D - 11		
τοται	(Words	9	Dollars		
10111		\$	Dollars		
Altern	ate 1:				
A. ]	EXPAN	DED LOBBY (ADD)			
TOTAL	. (Figure	s):			
TOTAT	(W 1	\$	Dollars		
IUIAL	L (words	\$): \$	Dollars		
2.	2. The undersigned agrees to maintain the proposal price for a period of 30 calendar days after bid opening.				
3.	The undersigned agrees, if awarded a contract, to complete all work as shown in the Contract Documents by the substantial completion date listed below.				
4.	The undersigned agrees that, prior to commencement of the Work, and within 7 calendar days of Notice of Intent to Award, to:				
	A.	Enter into and execute a contract for the work in the form of Fern "Construction Contract".	n Ridge School District,		
	B.	Deliver to the Owner duly executed AIA Document G705, "Certification ACORD form 25S.	ificate of Insurance," or		
	C.	Deliver to the Owner duly executed AIA Document A312, "P Payment Bond."	erformance Bond and		

- 5. The undersigned certifies that this Bid has been prepared independently and is not made in the interests of any undisclosed party. It is submitted without collusion or intent to limit independent, competitive bidding. The Bidder has in no way induced or solicited other Bidders to submit false bids, or to refrain from bidding.
- 6. The undersigned agrees that the provisions of ORS 279C.515 to 279C.545 and 279C.800 to 279C.970 pertaining to prevailing wage rates will be included in the Agreement if applicable.
- 7. Indicate below whether Bidder is Resident or Non Resident bidder. "Resident Bidder" means a bidder that has paid unemployment taxes or income taxes in Oregon during the twelve calendar months immediately preceding submission of bid, has a business address in this state and has stated in the bid whether the bidder is a "Resident Bidder" pursuant in 279C.365.
- 8. The undersigned certifies that you visited the site and thoroughly investigated all existing conditions.
- Security Deposit

   Bids shall be accompanied by a security deposit as follows: Bid Bond of a sum no less that 10 percent on AIA A310 Bid Bond Form

b. Endorse the Bid Bond in the name of Fern Ridge School District as oblige, signed and sealed by the principal (Contractor) and surety

c. The security deposit will be returned after delivery to the Fern Ridge School District of the required Performance and Payment Bond by the accepted bidder

d. Include the cost of the bid security in the Bid Amount

e. If no contract is awarded, all security deposits will be returned.

- 10. Start of construction after contract execution and permitting is May 2, 2016. Substantial Completion is December 16, 2016. Final Completion is December 30, 2016. (Unless Dates changed by Addenda)
- 11. If applicable the first tier subcontractor disclosure form is due 2 hours after bid closing.
- 12. Submittals are due promptly after Letter of Intent. A Pre-Construction Meeting will be held prior to commencement, Weekly Construction meetings are required.

SIGNATURES	
Oregon Construction Contractor's Board No	
Federal Tax ID:	_
Address:	
Telephone:	
Signature:	
Date:	
Printed Name:	
Title:	

# ATTACHMENT D FIRST TIER SUBCONTRACTOR DISCLOSURE FORM

List below the name of each subcontractor that will be furnishing labor or will be furnishing labor and materials and this is required to be disclosed, the category of work that the subcontractor will be performing and the dollar value of the subcontract. <u>Enter "NONE" if there are no subcontractors that need to be disclosed.</u>

Subcontractor Name	Category of Work	Dollar value

Failure to submit this form by the disclosure deadline (Tuesday, March 29, 2016 at 4:00 pm PST) will result in a nonresponsive bid. A nonresponsive bid will not be considered for award.

Respondent Name:

Authorized Representative's Signature:

Type or Print Name & Title:

Date:

#### SECTION 004005 - LIST OF QUALIFIED BIDDERS

#### List of Qualified Bidders

The following list is of all Contractors who qualified to submit bids for the upcoming Elmira High School Auxiliary Gymnasium and Renovations Project:

2G Construction Eugene, OR Contact: Doug Jost Phone: 541-689-3850 Fax: 541-689-3915 djost@2gconstruction.com

Bineham Construction Eugene, OR Contact: Ron Harrison Phone: 541-484-9405 Fax: 541-302-5926 ron@binehamconstruction.com

Chambers Construction Eugene, OR Contact: Brian Anderson Phone: 541-687-9445 Fax: 541-687-9451 banderson@chambers-gc.com

GBC Construction Corvallis, OR Contact: Cody Timmins Phone: 541-752-0381 ext. 303 Fax: 541-752-0472 cody@gbcconstruct.com

LCG Pence Construction Salem, OR Contact: Jason Krawczyk Phone: 503-399-7223 Fax: 503-585-7477 jasonk@lcgp.com

#### SECTION 004010 – CONSTRUCTION MILESTONE SCHEDULE

# Construction Milestone Schedule Elmira High School Aux Gym Fern Ridge School District

	Key Dates	Start Date	End Date
1.	Intent to Award		3/30/2016
2.	Notice to Proceed		4/11/2016
3.	Last School Day		6/17/2016
4.	Girl's Locker Area	5/2/2016	8/12/2016
5.	Aux Gym Construction	6/20/2015	12/16/2016
6.	First Day of Fall Semester		9/6/2016
7.	Substantial Completion		12/16/2016
8.	Final Completion		12/30/2016

SECTION 004020 - ALTERNATES

#### PART 1 GENERAL

- 1.1 Alternative Bid Items (Alternates) are described throughout the Contract Documents (Drawings and Specifications). Procedures for recording and noting alternate bid items are indicated in Section 002113 Instructions to Bidders. Contractor shall note description of alternate bid items and provide an individual separate price, which includes all costs necessary to add or deduct the cost of said bid item from the Base Bid price. Both additive and deductive bid alternates are indicated on the Drawings and Specifications.
- 1.2 The Owner reserves the right to accept any one, all, or none of the alternate bid items. The determination of the lowest bona fide bid will include an evaluation of alternates to be accepted by the Owner.
- 1.3 In preparing his price for each alternate bid item, the Contractor shall include all costs necessary to provide and install complete and in operating order in accordance with Contract Documents, and as indicated in the General Requirements and General Conditions, all component parts necessary to add or deduct each alternate bid item individually.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF ALTERNATES SECTION SECTION 005200 - SAMPLE CONSTRUCTION CONTRACT

# **CONSTRUCTION CONTRACT**

Where the basis of payment is a STIPULATED SUM

AGREEMENT made as of:	April 4 <sup>th</sup> , 2016
BETWEEN the District:	Fern Ridge School District 28J 88834 Territorial Rd Elmira, OR 97437
And the Contractor:	EXAMPLE Construction, Inc. 123 Main St Somewhere, USA
The Project is:	Elmira High School Auxiliary Gymnasium and Locker Room Renovations DLR GROUP PROJECT NO. 74-13107-40

In consideration of the covenants herein below set forth, EXAMPLE Construction, Inc., hereafter referred to as CONTRACTOR, and the FERN RIDGE SCHOOL DISTRICT 28J, hereafter referred to as DISTRICT, mutually contract as follows:

- A. CONTRACTOR agrees and covenants to perform all work indicated for the general construction services for the project as described in the contract documents for Elmira High School Auxiliary Gymnasium and Locker Room Renovations, for a total sum price of \$X,XXX,XXX.
- B. CONTRACTOR agrees to complete full performance for all work under the contract in accordance with all terms, plans, and specifications in the contract documents. The project will be complete by the dates stipulated by the contract documents and as shown in Exhibit 1.
- C. Payment shall be due on a monthly basis throughout the duration of the project. The DISTRICT shall make progress payments based on a percent completion of the work, within 30 days, when CONTRACTOR submits evidence satisfactory to the DISTRICT of having appropriately paid all payrolls, material bills, and other indebtedness connected with the work, and of having fully complied with all laws and terms of the contract. Payment shall be

made promptly in accordance with ORS 279C.505, and both parties shall have all the rights and duties specified in ORS 279C.515 (incorporated herein by this reference), and including the right to withhold retainage, as specified in ORS 279C.550 – ORS 279C.580.

- D. CONTRACTOR agrees that the DISTRICT shall not be responsible or liable for any payment for additional work or cost over the contract total. The DISTRICT must preapprove, in advance and in writing, any necessary work beyond this contract total. The DISTRICT, in its discretion, may require the execution of a contract amendment by the parties prior to any obligation to pay for additional work, or may issue an amended purchase order. Any DISTRICT obligation to pay is conditioned upon the work being performed in accordance with this contract, subject to its terms unless specified otherwise, and performed satisfactorily at the direction of the DISTRICT. Any payment is limited to compensation for actual quantities of work performed or other specified payment basis, taking into account any amounts that may be deductible under this contract.
- E. CONTRACTOR shall comply with all provisions of the Standard Contract Provisions, attached as appendix B and incorporated by this reference, and the Fern Ridge School District General Provisions.
- F. Each worker in each trade or occupation employed in the performance of the contract either by the CONTRACTOR, subcontractor, or other person doing, or contracting to do, or contracting for the whole or any part of the work on the contract, must be paid not less than the applicable state prevailing rate of wage. CONTRACTOR must pay daily, weekly, weekend and holiday overtime as specified in law. The BOLI rates in effect on the date of the execution of the contract shall be the applicable BOLI Prevailing Wage Rate and will be the rate fixed for the duration of the project. Once before the first payment, and once each week thereafter, and once before final payment of any sum due hereunder, CONTRACTOR, any subcontractor or their sureties, shall file a certificate of rate of wage as required by ORS 279C.845. If the DISTRICT determines at any time that the prevailing rate of wages has not or is not being paid as required herein, it may retain from the moneys due to CONTRACTOR an amount sufficient to make up the difference between the wages actually paid and the prevailing rate of wages, and may also cancel the contract. CONTRACTOR shall be liable to the workers affected for failure to pay the required rate of wage in the amount of their unpaid minimum wages, including all fringe benefits under ORS 279C.840(5), and in an additional amount equal to said unpaid wages as liquidated damages. CONTRACTOR shall include a contract provision in compliance with this paragraph in every subcontract, and shall require each subcontractor to include in each additional subcontract or contract. Within 20 days of the end of any month in which work was performed, CONTRACTOR shall provide the DISTRICT with a completed WH 38 BOLI payroll form. Reports should be mailed to Quanah Bennett, Business Manager, Fern Ridge School District, 88834 Territorial Rd, Elmira, OR 97437, or emailed to gbennett@fernridge.k12.or.us.
- G. The DISTRICT will retain 5% of any amount earned by CONTRACTOR on the project until CONTRACTOR has filed the certified statements required weekly. The DISTRICT will pay to CONTRACTOR the amount retained within 14 days after CONTRACTOR files the required certified statements, regardless of whether a subcontractor has failed to file certified

statements. As required in ORS 279C.845, CONTRACTOR shall retain 5% of any amount earned by a first tier subcontractor on the project until the first tier subcontractor has filed with the DISTRICT the certified statements required by this agreement. Before paying any amount retained, CONTRACTOR shall verify that the first tier subcontractor has filed the certified statement. Within 14 days after the first tier subcontractor files the required certified statement, CONTRACTOR shall pay the first tier subcontractor any amount retained. CONTRACTOR shall require all other subcontractors to file certified statements regarding payment of prevailing wage rates with the DISTRICT.

- H. If the CONTRACTOR or a first-tier subcontractor fails, neglects or refuses to make payment to persons furnishing labor or materials in connection with the public contract for a public improvement within 30 days after receipt of payment from the public contracting agency or a contractor, the CONTRACTOR or first tier subcontractor shall owe the person the amount due plus interest commencing at the end of the 10-day period that payment is due under ORS 279C.580(3) and ending upon final payment, unless payment is subject to a good faith dispute as defined in ORS 279C.580. The rate of interest shall be as provided in ORS 279C.515 (2).
- I. CONTRACTOR shall include in each subcontract for labor or services in connection with a public improvement, including a material supplier, for the purpose of performing a construction contract:
  - 1. A payment clause that obligates the CONTRACTOR to pay the first-tier subcontractor for satisfactory performance under its subcontract within 10 days out of such amounts as are paid to the CONTRACTOR by the public contracting agency under such contract, and
  - 2. An interest penalty clause that obligates the CONTRACTOR, if payment is not made within 30 days after receipt of payment from the public contracting agency to pay to the first-tier subcontractor an interest penalty on amounts due in the case of each payment not made in accordance with the payment clause included in the subcontract pursuant to paragraph (1) above for the period beginning on the day after the required payment date and ending on the date on which payment of the amount due is made and computed at the rate specified in ORS 279C.515. The rate of interest charged to the contractor or first-tier subcontractor on the amount due shall equal three times the discount rate on 90-day commercial paper in effect at the Federal Reserve Bank in the Federal Reserve district that includes Oregon on the date that is 30 days after the date when payment was received from the public contracting agency or from the contractor, but the rate of interest shall not exceed 30 percent. A contractor or first-tier subcontractor shall not be obligated to pay an interest penalty if the only reason that the contractor or first-tier subcontractor did not make payment when payment was due is that the contractor or first-tier subcontractor did not receive payment from the public contracting agency or contractor when payment was due.
  - 3. Terms and conditions that include prevailing wage payments, as detailed in Paragraph F of this section.
- J. If CONTRACTOR or subcontractor fails, neglects or refuses to make payment to a person furnishing labor or materials in connection with the public contract, the person may file a

complaint with the Construction Contractors Board, unless payment is subject to a good faith dispute as defined in ORS 279C.580.

- K. The CONTRACTOR shall require that the first-tier subcontractor include clauses in I.1-3 and J. above in each of its subcontracts, and that each lower-tier subcontractor or supplier include such clauses in each additional subcontract.
- L. The CONTRACTOR and each subcontractor shall have a public works bond in the amount of \$30,000 filed with the Construction Contractors Board before starting work, unless exempt. CONTRACTOR shall provide certification that CONTRACTOR and all subcontractors have filed the required public works bond.
- M. The performance under this contract is at CONTRACTOR'S sole risk. The service or services to be rendered under this contract are those of an independent contractor who is not an officer, employee, or agent of THE DISTRICT as those terms are used in ORS 30.265. Notwithstanding the Oregon Tort Claims Act, except as they apply to CONTRACTOR, or provisions of any other contract, CONTRACTOR is acting as and assumes liability of an independent contractor as to claims between the DISTRICT and CONTRACTOR. CONTRACTOR is solely liable for any Workers' Compensation coverage, social security, unemployment insurance or retirement payments, and federal or state taxes due as a result of payments under this contract. Any subcontractor hired by the CONTRACTOR shall be similarly responsible.
- N. CONTRACTOR agrees to indemnify, defend and hold the DISTRICT, its Board, agents, officers and employees, harmless and defend all damages, losses and expenses included but not limited to attorney's fees, and to defend all claims, proceedings, lawsuits and judgments arising out of or resulting from the fault of the CONTRACTOR, the CONTRACTOR'S agents, representatives or subcontractors, in the performance of or failure to perform this contract. However, CONTRACTOR shall not be required to indemnify any indemnitee to the extent the damage, loss or expense is caused by the indemnitee's negligence.
- O. By execution of this contract, CONTRACTOR certifies under penalty of perjury that to the best of CONTRACTOR'S knowledge, CONTRACTOR is not in violation of any tax laws described in ORS 305.380(4) and CONTRACTOR has not discriminated against minority, women or small business enterprises in obtaining any required subcontract.
- P. CONTRACTOR may only substitute a first-tier subcontractor that was not disclosed under ORS 279C.370 in accordance with statutory criteria, including demonstration of inadvertent error, the subcontractor's failure or refusal to execute or perform under a written contract, to meet bond requirements, to perform substantially satisfactory work or affirmatively causing substantial delay or disruption to work progress, subcontractor's bankruptcy or insolvency, or failure to be registered with Construction Contractors Board if required, or otherwise be eligible to work on a public improvement project pursuant to applicable statutory provisions. CONTRACTOR is solely responsible for ensuring that any subcontractor selection and substitution has been in accordance with all legal requirements, including compliance with lobbying disclosure and federal debarment restrictions. The DISTRICT shall

SAMPLE CONSTRUCTION CONTRACT
not be liable, either directly or indirectly, in any dispute arising out of CONTRACTOR'S actions with regard to subcontractor selection and substitution.

- Q. The DISTRICT reserves the right to reject any bid or to refuse delivery of materials or services at or from any manufacturer, plant, or contractor with which the DISTRICT has reasonable grounds to believe is or may be operating in violation of any local, State or Federal laws or which is the subject of pending litigation.
- R. In order to induce the DISTRICT to enter into this Agreement CONTRACTOR makes the following representations:
  - 1. CONTRACTOR has examined and carefully studied the contract documents and the other related data.
  - 2. CONTRACTOR has visited the sites and become familiar with and is satisfied as to the general, local, and site conditions that may affect cost, progress, and performance of the project.
  - 3. CONTRACTOR 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 project.
  - 4. CONTRACTOR has obtained and carefully studied (or assumes responsibility for doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and underground facilities) at or contiguous to the site which may affect cost, progress, or performance of the project or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by CONTRACTOR, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents, and safety precautions and programs incident thereto.
  - 5. CONTRACTOR does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the project at the contract price, within the contract times, and in accordance with the other terms and conditions of the contract documents.
  - 6. CONTRACTOR is aware of the general nature of work to be performed by the DISTRICT and others at the site that relates to the project as indicated in the contract documents.
  - 7. CONTRACTOR has correlated the information known to CONTRACTOR, information and observations obtained from visits to the site, reports and drawings identified in the contract documents, and all additional examinations, investigations, explorations, tests, studies, and data with the contract documents.
  - 8. CONTRACTOR has given the DISTRICT written notice of all conflicts, errors, ambiguities, or discrepancies that CONTRACTOR has discovered in the contract documents, and the written resolution thereof by the DISTRICT is acceptable to CONTRACTOR.
  - 9. The contract documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the project.
- S. By execution of this agreement, CONTRACTOR agrees to be bound by all the contract documents.
  - 1. The contract documents consist of the following:

SAMPLE CONSTRUCTION CONTRACT

- a) This Construction Contract and the attached standard provisions (Appendix B)
- b) Drawings and project manuals
- c) Any addenda issued
- d) Contractors' Bid
- e) Modifications issued after execution of the Contract. Modifications may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto.
- 2. A modification is (1) an amended Purchase Order, (2) a written amendment to the Contract, (3) a Field Order including the Notice to Proceed, (4) a Change Order, (5) a Change Directive, (6) or a written order for a minor change in the Work issued by the Engineer.
- 3. Contract documents do not include other documents, or portions of documents, covering bidding requirements, bidding instructions or sample forms.
- 4. Any conflict or difference between the contract documents shall be called to the attention of THE DISTRICT by CONTRACTOR before proceeding with affected work. In the event that any conflict arises because of differences among the documents listed in Section S.1., the order of precedence shall be in the order listed in Section S.1.
- T. CONTRACTOR shall provide all insurance called for in Appendix A Insurance Coverage Required and Section G of the general conditions. As evidence of the insurance coverage required by this contract, the CONTRACTOR shall furnish a certificate of insurance to the DISTRICT. The certificate will specify parties who are Additional Insured and must include a notice provision regarding cancellations. Insurance coverage required under this contract shall be obtained from insurance companies authorized to do business in the State of Oregon. If CONTRACTOR is self-insured under the laws of the State of Oregon, CONTRACTOR shall provide appropriate declarations of coverage.
  - 1. CONTRACTOR shall not cancel, materially change, or not renew insurance coverages. CONTRACTOR shall notify the DISTRICT, of any material reduction or exhaustion of aggregate limits. Should any policy be cancelled before final payment to the DISTRICT and should CONTRACTOR fail to immediately procure other insurance as specified, the DISTRICT reserves the right to procure such insurance and charge CONTRACTOR for the cost thereof. Any insurance bearing any adequacy of performance shall be maintained after completion of the contract for the full guaranteed period, and should the CONTRACTOR fail to immediate procure such insurance as specified, the DISTRICT reserves the right to procure such insurance and to charge the cost thereof to CONTRACTOR.
- U. The CONTRACTOR's work is subject to terms and conditions of permits issued by the State, the County, and/or other local agencies.

#### Additional Terms

In addition to other provisions, including but not limited to those in the General Conditions the parties agree:

1. No action or failure to act by Owner, Engineer or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act

SAMPLE CONSTRUCTION CONTRACT

constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

- 2. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the contract documents.
- 3. THE DISTRICT and CONTRACTOR each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the contract documents.
- 4. Both the DISTRICT and CONTRACTOR have full power, authority and legal right to make this Contract and to incur and perform its obligations hereunder.
- 5. The making and performance by CONTRACTOR of this Agreement (1) have been duly authorized by all necessary action of CONTRACTOR and (2) do not and will not violate any provision of any applicable law, rule, regulation, or order of any court, regulatory commission, board, or other administrative agency and (3) do not and will not result in the breach of, or constitute a default or require consent under any other agreement or instrument to which CONTRACTOR is a party or by which CONTRACTOR may be bound or affected.
- 6. This Contract has been duly executed and delivered by CONTRACTOR and constitutes a legal, valid and binding obligation of CONTRACTOR, enforceable in accordance with its terms subject to the laws of bankruptcy, insolvency, or other similar laws affecting the enforcement of creditors' rights generally.
- 7. CONTRACTOR and the DISTRICT recognize that time is of the essence of this Agreement and that the DISTRICT will suffer financial loss if the work is not completed within the times specified in the Contract, plus any extensions thereof allowed in accordance with Section H of the General Conditions.
- 8. The parties certify that they have read and understood this Contract and agree to be bound by its terms, and agree that their representatives executing this Contract are authorized to do so on their behalf.
- 9. CONTRACTOR and subcontractors shall make and maintain for a period of six (6) years from the completion of work, records necessary to determine whether the prevailing rate of wage and overtime has been or is being paid to workers upon public works.
- 10. The DISTRICT standard contract provisions are incorporated by reference.
- 11. The DISTRICT shall pay the required prevailing wage fee to the Commissioner of the Bureau of Labor and Industries.

IN WITNESS WHEREOF, the parties have executed this contract on the below said date.

For the FERN RIDGE SCHOOL DISTRICT 28J:

	Date:
Name: Dr. Sally Storm	Title: Superintendent
For EXAMPLE CONSTRUCTION, INC.:	
	Date:
Name:	Title:

# APPENDIX A INSURANCE COVERAGE REQUIRED

Respondent shall not commence any work until Respondent obtains, at Respondent's own expense, all required insurance as specified below. Such insurance must have the approval of the District as to limits, form and amount and must include FERN RIDGE SCHOOL DISTRICT 28J as an insured party. The types of insurance Respondent is required to obtain or maintain for the full period of the contract will be:

**COMPREHENSIVE COMMERCIAL GENERAL LIABILITY** insurance including personal injury, bodily injury and property damage with limits as specified below. The insurance shall include:

COVERAGES Explosion & Collapse Underground Hazard Products/Completed Operations Contractual Liability LIMITS \$1,000,000 per occurrence \$2,000,000 general aggregate

# FORM

All policies must be of the occurrence form with combined single limit for bodily injury and property damage. Any deviation from this must be reviewed by the Project Manager. All claims-made forms must have tail coverage and the prior approval of Project Manager. Submit a complete copy of claims-made policies and endorsements with the certificate of insurance.

**AUTOMOBILE LIABILITY** insurance comprehensive form with limits as specified below. The coverage shall include owned, hired and non-owned automobiles and include FERN RIDGE SCHOOL DISTRICT 28J and its board and employees as additional insureds.

#### LIMITS:

\$2,000,000 combined single limit per accident for bodily injury and property damage \$1,000,000 combined single limit per accident or occurrence \$2,000,000 all claimants per accident or occurrence (aggregate)

**ADDITIONAL INSURED CLAUSE** The general and auto liability insurance coverage's required for performance of this contract shall be endorsed to name FERN RIDGE SCHOOL DISTRICT 28J and its board, officers, agents and employees as additional insureds on any insurance policies required herein with respect to Respondent's activities being performed under the Contract. The additional insureds must be named as an additional insured by endorsement, and the policy must be endorsed to show cancellation notices to FERN RIDGE SCHOOL DISTRICT 28J. Coverage shall be primary and non-contributory with any other insurance and self-insurance.

**WORKERS' COMPENSATION AND EMPLOYER'S LIABILITY** as statutorily required for persons performing work under this contract. Any subcontractors hired by Respondent shall also carry Workers' Compensation and Employers' Liability coverage.

LIMITS: \$1,000,000 employer's liability

SAMPLE CONSTRUCTION CONTRACT

Any questions concerning insurance and indemnity should be directed to the District. **APPENDIX B STANDARD CONTRACT PROVISIONS** 

- A. The following standard public contract clauses shall be included expressly or by reference where appropriate in every contract of the District.
  - 1. Contractor shall make payment promptly, as due, to all persons supplying to such contractor labor or material for the prosecution of the work provided for in the contract, and shall be responsible for payment to such persons supplying labor or material to any subcontractor.
  - 2. Contractor shall pay promptly all contributions or amounts due to the State Industrial Accident Fund and the State Unemployment Compensation Fund from contractor or any subcontractor in connection with the performance of the contract.
  - 3. Contractor shall not permit any lien or claim to be filed or prosecuted against the District on account of any labor or material furnished, shall assume responsibility for satisfaction of any lien so filed or prosecuted and shall defend against, indemnify and hold County harmless from any such lien or claim.
  - 4. Contractor and any subcontractor shall pay to the Department of Revenue all sums withheld from employees pursuant to ORS 316.167.
  - 5. For public improvement and construction contracts only, if contractor fails, neglects or refuses to make prompt payment of any claim for labor or services furnished to the contractor or a subcontractor by any person in connection with the public contract as such claim becomes due, the District may pay such claim to the person furnishing the labor or services and charge the amount of the payment against funds due or to become due the contractor by reason of the contract. The payment of a claim in the manner authorized hereby shall not relieve the contractor or its surety from the obligation with respect to any unpaid claim. If the District is unable to determine the validity of any claim for labor or services furnished, the District may withhold from any current payment due contractor an amount equal to said claim until its validity is determined, and the claim, if valid, is paid by the contract or or the District. There shall be no final acceptance of the work under the contract until all such claims have been resolved.
  - 6. Contractor shall make payment promptly, as due, to any person, co-partnership, association or corporation furnishing medical, surgical, hospital or other needed care and attention, incident to sickness or injury, to the employees of contractor, of all sums which the contractor agreed to pay or collected or deducted from the wages of employees pursuant to any law, contract or agreement for the purpose of providing payment for such service.
  - 7. With certain exceptions listed below, contractor shall not require or permit any person to work more than 10 hours in any one day, or 40 hours in any one week except in case of necessity, emergency, or where public policy absolutely requires it, and in such cases the person shall be paid at least time and a half for:
    - a) All overtime in excess of eight hours a day or 40 hours in any one week when the work week is five consecutive days, Monday through Friday, or

- b) All overtime in excess of 10 hours a day or 40 hours in any one week when the work week is four consecutive days, Monday through Friday, and
- c) All work performed on the days specified in ORS 279B.020 (1) for non-public improvement contracts or ORS 279C.540 (1) for public improvement contracts.
- d) For personal/professional service contracts as designated under ORS 279A.055, instead of (a) and (b) above, a laborer shall be paid at least time and a half for all overtime worked in excess of 40 hours in any one week, except for individuals under these contracts who are excluded under ORS 653.010 to 653.261 or under 29 U.S.C. Sections 201 to 209, from receiving overtime.
- e) Contractor shall follow all other exceptions, pursuant to ORS 279B.235 (for nonpublic improvement contracts) and ORS 279C.540 (for public improvement contracts), including contracts involving a collective bargaining agreement, contracts for services, and contracts for fire prevention or suppression. For contracts other than construction or public improvements, this subsection (7) does not apply to contracts for purchase of goods or personal property.
- f) Contractor must give notice to employees who work on a public contract in writing, either at the time of hire or before commencement of work on the contract, or by posting a notice in a location frequented by employees, of the number of hours per day and days per week that the employees may be required to work.
- 8. The hourly rate of wage to be paid by any contractor or subcontractor to workers upon all public works shall be not less than the applicable prevailing rate of wage for an hour's work in the same trade or occupation in the locality where such labor is performed, in accordance with ORS 279C.800 to ORS 279C.850.
- 9. The contractor, its subcontractors, if any, and all employers working under the contract are subject employers under the Oregon Workers' Compensation Law and shall comply with ORS 656.017, or otherwise be exempt under ORS 656.126.
- 10. As to public improvement and construction contracts, Contractor shall comply with all applicable federal, state, and local laws and regulations, including but not limited to those dealing with the prevention of environmental pollution and the preservation of natural resources that affect the performance of the contract. A list of entities who have enacted such laws or regulations is found in the Oregon Attorney General's Model Public Contract Rules Manual, OAR 137-030-0010, Commentary 4. If new or amended statutes, ordinances, or regulations are adopted, or the contractor encounters a condition not referred to in the bid document not caused by the contractor and not discoverable by reasonable site inspection which requires compliance with federal, state, or local laws or regulations dealing with the prevention of environmental pollution or the preservation of natural resources, both the District and the contractor shall have all the rights and obligations specified in ORS 279C.525 to handle the situation.
- 11. The contract may be canceled at the election of the District for any substantial breach, willful failure or refusal on the part of contractor to faithfully perform the contract according to its terms. The District may terminate the contract by written order or upon request of the contractor, if the work cannot be completed for reasons beyond the control of either the contractor or the District, or for any reason considered to be in the public interest other than a labor dispute, or by reason of any third party judicial proceeding relating to the work other than one filed in regards to a labor dispute, and

when circumstances or conditions are such that it is impracticable within a reasonable time to proceed with a substantial portion of the work. In either case, for public improvement contracts, if the work is suspended but the contract not terminated, the contractor is entitled to a reasonable time extension, costs and overhead per ORS 279C.655. Unless otherwise stated in the contract, if the contract is terminated, the contractor shall be paid per ORS 279C.660 for a public improvement contract.

- 12. If the District does not appropriate funds for the next succeeding fiscal year to continue payments otherwise required by the contract, the contract will terminate at the end of the last fiscal year for which payments have been appropriated. The District will notify the contractor of such non-appropriation not later than 30 days before the beginning of the year within which funds are not appropriated. Upon termination pursuant to this clause, the District shall have no further obligation to the contractor for payments beyond the termination date. This provision does not permit the District to terminate the contract in order to provide similar services or goods from a different contractor.
- 13. By execution of this contract, contractor certifies, under penalty of perjury that:
  - a) To the best of contractor's knowledge, contractor is not in violation of any tax laws described in ORS 305.380(4), and
  - b) Contractor has not discriminated against minority, women or small business enterprises in obtaining any required subcontracts.
  - c) Contractor is in full compliance with all applicable state and federal laws and is not debarred under either state or federal regulations.
- 14. Contractor agrees to prefer goods or services that have been manufactured or produced in this State if price, fitness, availability or quality are otherwise equal.
- 15. Contractor agrees to not assign this contract or any payments due hereunder without the proposed assignee being first approved and accepted in writing by the District.
- 16. Contractor agrees to make all provisions of the contract with the District applicable to any subcontractor performing work under the contract.
- 17. The District will not be responsible for any losses or unanticipated costs suffered by contractor as a result of the contractor's failure to obtain full information in advance in regard to all conditions pertaining to the work.
- 18. All modifications and amendments to the contract shall be effective only if in writing and executed by both parties.
- 19. The contractor certifies he or she has all necessary licenses, permits, or certificates of registration (including Construction Contractors Board registration or Landscape Contractors Board license, if applicable), necessary to perform the contract and further certifies that all subcontractors shall likewise have all necessary licenses, permits or certificates before performing any work. The failure of contractor to have or maintain such licenses, permits, or certificates is grounds for rejection of a bid or immediate termination of the contract.
- 20. Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin in hiring and Contractor will further not discriminate against any employee during employment of any person because of race, color, religion, sex, or national origin. Contractor will send notice of this non-discrimination policy to any labor union or representative of workers, and shall pose in conspicuous places notices setting forth the provisions of this on discrimination clause.

- 21. The Oregon Standard Specifications for Construction adopted by the State of Oregon, and the Manual on Uniform Traffic Control Devices, each as is currently in effect, shall be applicable to all road construction projects.
- 22. When a public contract is awarded to a nonresident bidder and the contract price exceeds \$10,000, the contractor shall promptly report to the Department of Revenue on forms to be provided by the department the total contract price, terms of payment, length of contract and such other information as the department may require before the DISTRICT will make final payment on the contract.

SECTION 007000 – GENERAL CONDITIONS

#### GENERAL CONDITIONS

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#### GENERAL CONDITIONS

#### SECTION A GENERAL PROVISIONS

#### A.1 DEFINITION OF TERMS

In the Contract Documents the following terms shall be as defined below:

ARCHITECT/ENGINEER, means the Person appointed by the Owner to make drawings and specifications and, to provide contract administration of the Work contemplated by the Contract to the extent provided herein or by supplemental instruction of Owner (under which Owner may delegate responsibilities of the Owner's Authorized Representative to the Architect/Engineer), in accordance with ORS Chapter 671 (Architects) or ORS Chapter 672 (Engineers). SECTION L LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

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CHANGE ORDER, means a written order issued by the Owner's Authorized Representative to the Contractor requiring a change in the Work within the general scope of the Contract Documents, issued under the changes provisions of Section D.1 in administering the Contract, including Owner's written change directives as well as changes reflected in a writing executed by the parties to this Contract and, if applicable, establishing a Contract Price or Contract Time adjustment for the changed Work.

CLAIM, means a demand or assertion by Contractor seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of Contract Time or other relief pursuant to Section D.3.

# ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON CONTRACT, means the written agreement between the Owner and the Contractor comprised of the Contract Documents which describe the Work to be done and the obligations between the parties.

CONTRACT DOCUMENTS, means the Solicitation Document and addenda thereto, the Agreement Form, General Conditions, Supplemental General Conditions, if any, the accepted Offer, Plans, Specifications, amendments and Change Orders.

CONTRACT PERIOD, as set forth in the Contract Documents, means the total period of time beginning with the issuance of the Notice to Proceed and concluding upon Final Completion.

CONTRACT PRICE, means the total of the awarded Offer amount, as increased or decreased by the price of approved alternates and Change Orders.

CONTRACT TIME, means any incremental period of time allowed under the Contract to complete any portion of the Work as reflected in the project schedule.

CONTRACTOR, means the Person awarded the Contract for the Work contemplated.

DAYS, are calendar days, including weekdays, weekends and holidays, unless otherwise specified.

DIRECT COSTS, means, unless otherwise provided in the Contract Documents, the cost of materials, including sales tax, cost of delivery; cost of labor, including social security, old age and unemployment insurance, and fringe benefits required by agreement or custom; worker's compensation insurance; project specific insurance; bond premiums, rental cost of equipment, and machinery required for execution of the work; and the additional costs of field personnel directly attributable to the Work.

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FINAL COMPLETION, means the final completion of all requirements under the Contract, including Contract Closeout as described in Section K but excluding Warranty Work as described in Section I.2, and the final payment and release of all retainage, if any, released.

FORCE MAJEURE, means an act, event or occurrence caused by fire, riot, war, acts of God, nature, sovereign, or public enemy, strikes, freight embargoes or any other act, event or occurrence that is beyond the control of the party to this Contract who is asserting Force Majeure.

MILESTONE, means a scheduled event that establishes the completion of a major deliverable element of a project. A milestone is measurable, observable and serves as a progress marker. Milestones must be included in the project's approved schedule and will not change without written approval by owner.

NOTICE TO PROCEED, means the official written notice from the Owner stating that the Contractor is to proceed with the Work defined in the Contract Documents. Notwithstanding the Notice to Proceed, Contractor shall not be authorized to proceed with the Work until all initial Contract requirements, including the Contract, performance bond and payment bond, and certificates of insurance, have been fully executed and submitted to Owner in a suitable form.

OFFER, means a bid in connection with an invitation to bid and a proposal in connection with a request for proposals.

OFFEROR, means a bidder in connection with an invitation to bid and a proposer in connection with a request for proposals.

OVERHEAD, means those items which may be included in the Contractor's markup (general and administrative expense and profit) but shall not include items such as wages or salary of personnel working at the job site (including

supervisory personnel above the level of foreman such as superintendents and project managers stationed at the job site), expenses of the Contractor's temporary job site office (including personnel staffing that office), or other items that are charged as Direct Cost of the Work.

OWNER, means Fern Ridge School District 28J.

#### **OWNER'S AUTHORIZED**

REPRESENTATIVE, means those individuals identified in writing by the Owner to act on behalf of the Owner for this project. Owner may elect, by written notice to Contractor, to delegate certain duties of the Owner's Authorized Representative to more than one party, including without limitation, to an Architect/Engineer. However, nothing in these General Conditions is intended to abrogate the separate design professional responsibilities of Architects under ORS Chapter 671 or of Engineers under ORS Chapter 672.

PERSON, means an entity doing business as a sole proprietorship, a partnership, a joint venture, a corporation, a limited liability company or partnership, or any other entity possessing the legal capacity to contract.

PLANS, means the drawings which show the location, type, dimensions, and details of the Work to be done under the Contract.

PUNCHLIST, means the list of Work yet to be completed or deficiencies which need to be corrected in order to achieve Final Completion of the Contract.

RECORD DOCUMENT, means the as-built Plans, Specifications, testing and inspection records, product data, samples, manufacturer and distributor/supplier warranties evidencing transfer to Owner, operational and maintenance manuals, shop drawings, Change Orders, correspondence, certificate(s) of occupancy, and other documents listed in Subsection B.9.1 of these General Conditions, recording all Services performed.

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SOLICITATION DOCUMENT, means an invitation to bid or request for proposal or request for quotes.

SPECIFICATION, means any description of the physical or functional characteristics of the Work, or of the nature of a supply, service or construction item. Specifications may include a description of any requirement for inspecting, testing or preparing a supply, service or construction item for delivery and the quantities or qualities of materials to be furnished under the Contract. Specifications generally will state the results or products to be obtained and may, on occasion, describe the method and manner of doing the work to be performed. Specifications may be incorporated by reference and/or may be attached to the Contract.

SUBCONTRACTOR, means a Person having a direct contract with the Contractor, or another Subcontractor, to perform one or more items of the Work.

SUBSTANTIAL COMPLETION, means the date when the Owner accepts in writing the construction, alteration or repair of the improvement to real property or any designated portion thereof as having reached that state of completion when it may be used or occupied for its intended purpose. Substantial Completion of facilities with operating systems occurs only after thirty (30) continuous Days of successful, trouble-free operation of the operating systems as provided in Section K.4.2.

SUBSTITUTIONS, means items that in function, performance, reliability, quality, and general configuration are the same or better than the product(s) specified. Approval of any substitute item shall be solely determined by the Owner's Authorized Representative. The decision of the Owner's Authorized Representative is final.

SUPPLEMENTAL GENERAL CONDITIONS, means those conditions that remove from, add to, or modify these General Conditions. Supplemental General Conditions may be

#### ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON included in the Solicitation Document or may be a separate attachment to the Contract.

WORK, means the furnishing of all materials, equipment, labor, transportation, services and incidentals necessary to successfully complete any individual item or the entire Contract and the carrying out of duties and obligations imposed by the Contract Documents.

# A.2 SCOPE OF WORK

The Work contemplated under this Contract includes all labor, materials, transportation, equipment and services, for, and incidental to, the completion of all construction work in connection with the project described in the Contract Documents. The Contractor shall perform all Work necessary so that the project can be legally occupied and fully used for the intended use as set forth in the Contract Documents.

# A.3 INTERPRETATION OF CONTRACT DOCUMENTS

A.3.1 Unless otherwise specifically defined in the Contract Documents, words which have well-known technical meanings or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings. Contract Documents are intended to be complementary. Whatever is called for in one, is interpreted to be called for in all. However, in the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following descending order of precedence:

1. Contract amendments and Change Orders, with those of later date having precedence over those of an earlier date;

- 2. The Supplemental General Conditions;
- 3. The Agreement Form;
- 4. The General Conditions
- 5. The Plans and Specifications

6. The Solicitation Document and any addenda thereto;

### 7. The accepted Offer.

A.3.2 In the case of an inconsistency between Plans and Specifications or within either document not clarified by addendum, the better quality or greater quantity of Work shall be provided in accordance with the Owner or Owner's Authorized Representative's interpretation in writing.

A.3.3 If the Contractor finds discrepancies in, or omissions from the Contract Documents, or if the Contractor is in doubt as to their meaning, the Contractor shall at once notify the Owner or **Owner's Authorized Representative.** Matters concerning performance under, and interpretation of requirements of, the Contract Documents will be decided by the Owner's Authorized Representative, who may delegate that duty in some instances to the Architect/Engineer. Responses to Contractor's requests for interpretation of Contract Documents will be made in writing by Owner's Authorized Representative (or the Architect/Engineer) within any time limits agreed upon or otherwise with reasonable promptness. Interpretations and decisions of the Owner's Authorized Representative (or Architect/Engineer) will be consistent with the intent of and reasonably inferable from the Contract Documents. Contractor shall not proceed without direction in writing from the Owner's Authorized Representative (or Architect/Engineer).

A.3.4 References to standard specifications, manuals, codes of any technical society, organization or association, to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, laws or regulations in effect in the jurisdiction where the project is occurring on the first published date of the ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON Solicitation Document, except as may be otherwise specifically stated.

# A.4 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE

A.4.1 It is understood that the Contractor, before submitting an Offer, has made a careful examination of the Contract Documents; has become fully informed as to the quality and quantity of materials and the character of the Work required; and has made a careful examination of the location and conditions of the Work and the sources of supply for materials. The Owner will in no case be responsible for any loss or for any unanticipated costs that may be suffered by the Contractor as a result of the Contractor's failure to acquire full information in advance in regard to all conditions pertaining to the Work. No oral agreement or conversation with any officer, agent, or personnel of the Owner, or with the Architect/Engineer either before or after the execution of this Contract, shall affect or modify any of the terms or obligations herein contained.

A.4.2 Should the Plans or Specifications fail to particularly describe the materials, kind of goods, or details of construction of any aspect of the Work, Contractor shall have the duty to make inquiry of the Owner and Architect/Engineer as to what is required prior to performance of the Work. Absent Specifications to the contrary, the materials or processes that would normally be used to produce first quality finished Work shall be considered a part of the Contract requirements.

A.4.3 Any design errors or omissions noted by the Contractor shall be reported promptly to the Owner's Authorized Representative, including without limitation, any nonconformity with applicable laws, statutes, ordinances, building codes, rules and regulations.

A.4.4 If the Contractor believes that additional cost or Contract Time is involved because of clarifications or instructions issued by the Owner's Authorized Representative (or

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Architect/Engineer) in response to the Contractor's notices or requests for information, the Contractor must submit a written request to the Owner's Authorized Representative, setting forth the nature and specific extent of the request, including all time and cost impacts against the Contract as soon as possible, but no later than thirty (30) Days after receipt by Contractor of the clarifications or instructions issued. If the Contractor does not concur with the decision of the Owner's Authorized Representative regarding time and cost impacts of the clarifications or instructions, the Contractor may proceed to file a Claim under Section D.3. Claims Review Process. If the Contractor fails to perform the obligations of Sections A.4.1 to A.4.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations.

# A.5 INDEPENDENT CONTRACTOR STATUS

The service or services to be performed under this Contract are those of an independent contractor. Contractor represents and warrants that it is not an officer, employee or agent of the Owner as those terms are used in ORS 30.265.

# A.6 RETIREMENT SYSTEM STATUS AND TAXES

Contractor represents and warrants that it is not a contributing member of the Public Employees' Retirement System and will be responsible for any federal or state taxes applicable to payment received under this Contract. Contractor will not be eligible for any benefits from these Contract payments of federal Social Security, employment insurance, workers' compensation or the Public Employees' Retirement System, except as a self-employed individual. Unless the Contractor is subject to backup withholding, Owner will not withhold from such payments any amount(s) to cover Contractor's federal or state tax obligations.

#### ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON A.7 GOVERNMENT EMPLOYMENT STATUS

A.7.1 If this payment is to be charged against federal funds, Contractor represents and warrants that it is not currently employed by the Federal Government. This does not preclude the Contractor from holding another contract with the Federal Government.

A.7.2 Contractor represents and warrants that Contractor is not an employee of Fern Ridge School District 28J for purposes of performing Work under this Contract.

# SECTION B ADMINISTRATION OF THE CONTRACT

# B.1 OWNER'S ADMINISTRATION OF THE CONTRACT

B.1.1 The Owner's Authorized Representative will provide administration of the Contract as described in the Contract Documents (1) during construction (2) until final payment is due and (3) during the one-year period for correction of Work. The Owner's Authorized Representative will act on behalf of the Owner to the extent provided in the Contract Documents, unless modified in writing in accordance with other provisions of the Contract. In performing these tasks, the Owner's Authorized Representative may rely on the Architect/Engineer or other consultants to perform some or all of these tasks.

B.1.2 The Owner's Authorized Representative will visit the site at intervals appropriate to the stage of the Contractor's operations (1) to become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed, (2) to endeavor to guard the Owner against defects and deficiencies in the Work, and (3) to determine in general if Work is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. The Owner's Authorized Representative will not make exhaustive or continuous on-site inspections to check the

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quality or quantity of the Work. The Owner's Authorized Representative will neither have control over or charge of, nor be responsible for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work.

B.1.3 Except as otherwise provided in the Contract Documents or when direct communications have been specifically authorized, the Owner and Contractor shall endeavor to communicate with each other through the Owner's Authorized Representative or designee about matters arising out of or relating to the Contract. Communications by and with the Architect/Engineer's consultants shall be through the Architect/Engineer. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner's Authorized Representative.

B.1.4 Based upon the Architect/Engineer's evaluations of the Contractor's Application for Payment, or unless otherwise stipulated by the Owner's Authorized Representative, the Architect/Engineer will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

# B.2 CONTRACTOR'S MEANS AND METHODS; MITIGATION OF IMPACTS

B.2.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety

thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures.

B.2.2 The Contractor is responsible to protect and maintain the Work during the course of construction and to mitigate any adverse impacts to the project, including those caused by authorized changes, which may affect cost, schedule, or quality.

B.2.3 The Contractor is responsible for the actions of all its personnel, laborers, suppliers, and Subcontractors on the project. The Contractor shall enforce strict discipline and good order among Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of persons who are unfit or unskilled for the tasks assigned to them.

# **B.3 MATERIALS AND WORKMANSHIP**

B.3.1 The intent of the Contract Documents is to provide for the construction and completion in every detail of the Work described. All Work shall be performed in a professional manner and unless the means or methods of performing a task are specified elsewhere in the Contract Documents, Contractor shall employ methods that are generally accepted and used by the industry, in accordance with industry standards.

B.3.2 The Contractor is responsible to perform the Work as required by the Contract Documents. Defective Work shall be corrected at the Contractor's expense.

B.3.3 Work done and materials furnished shall be subject to inspection and/or observation and testing by the Owner's Authorized Representative to determine if they conform to the Contract Documents. Inspection of the Work by the Owner's Authorized Representative does not relieve the Contractor of responsibility for the Work in accordance with the Contract Documents. B.3.4 Contractor shall furnish adequate facilities, as required, for the Owner's Authorized Representative to have safe access to the Work including without limitation walkways, railings, ladders, tunnels, and platforms. Producers, suppliers, and fabricators shall also provide proper facilities and access to their facilities.

B.3.5 The Contractor shall furnish Samples of materials for testing by the Owner's Authorized Representative and include the cost of the Samples in the Contract Price.

#### **B.4 PERMITS**

Contractor shall obtain and pay for all necessary permits and licenses, except for those specifically excluded in B.4.1. below or in the Supplemental General Conditions, for the construction of the Work, for temporary obstructions, enclosures, opening of streets for pipes, walls, utilities, environmental Work, etc., as required for the project. Contractor shall be responsible for all violations of the law, in connection with the construction or caused by obstructing streets, sidewalks or otherwise. Contractor shall give all requisite notices to public authorities. The Contractor shall pay all royalties and license fees. The Contractor shall defend all suits or claims for infringement of any patent or other proprietary rights and save harmless and blameless from loss, on account thereof, the Fern Ridge School District 28J, and its board, departments,, employees, and volunteers.

B.4.1 The Owner will pay for the following permits. All others are the responsibility of the Contractor:

- 1. Building, Site, and Safety Plan Check Fee
- 2. Fire Department Plan Check Fee
- 3. Building Permit Fee
- 4. DEQ 1200-C Permit
- 5. State, Zone, and Seismic, Surcharge Fees

# B.5 COMPLIANCE WITH GOVERNMENT LAWS AND REGULATIONS

B.5.1 Contractor shall comply with all federal, state and local laws, codes, regulations and ordinances applicable to the Work and the Contract. Failure to comply with such requirements shall constitute a breach of Contract and shall be grounds for Contract termination. Without limiting the generality of the foregoing, Contractor expressly agrees to comply with the following as applicable: i) Title VI and VII of Civil Rights Act of 1964, as amended: (ii) Section 503 and 504 of the Rehabilitation Act of 1973, as amended; (iii) the Health Insurance Portability and Accountability Act of 1996; (iv) the Americans with Disabilities Act of 1990, as amended; (v) ORS Chapter 659A; as amended (vi) all regulations and administrative rules established pursuant to the foregoing laws; and (vii) all other applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations. Owner's performance under the Contract is conditioned upon Contractor's compliance with the provisions of ORS 279C.505, 279C.510, 279C.515, 279C.520, and 279C.530, which are incorporated by reference herein.

B.5.2 Contractor shall comply with all applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations; and

(a) Contractor shall not discriminate against Disadvantaged, Minority, Women or Emerging Small Business enterprises, as those terms are defined in ORS 200.005, in the awarding of subcontracts (ORS 279A.110).

(b) Contractor shall maintain, in current and valid form, all licenses and certificates required by law, regulation, or this Contract when performing the Work.

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B.5.3 Unless contrary to federal law, Contractor shall certify that it shall not accept a bid from Subcontractors to perform Work as described in ORS 701.005 under this Contract unless such Subcontractors are registered with the Construction Contractors Board in accordance with ORS 701.035 to 701.055 at the time they submit their bids to the Contractor.

B.5.4 Unless contrary to federal law, Contractor shall certify that each landscape contractor, as defined in ORS 671.520(2), performing Work under this Contract holds a valid landscape contractor's license issued pursuant to ORS 671.560.

B.5.5 The following notice is applicable to Contractors who perform excavation Work. ATTENTION: Oregon law requires you to follow rules adopted by the Oregon

Utility Notification Center. Those rules are set forth in OAR 952-001-0010 through OAR 952-001-0090. You may obtain copies of the rules by calling the center at (503)232-1987.

B.5.6 Failure to comply with any or all of the requirements of B.5.1 through B.5.5 shall be a breach of Contract and constitute grounds for Contract termination. Damages or costs resulting from such noncompliance shall be the responsibility of Contractor.

#### **B.6 SUPERINTENDENCE**

Unless stated otherwise in the Contract Documents, the Contractor shall keep on the site, during the progress of the Work, a competent superintendent and any necessary assistants who shall be satisfactory to the Owner and who shall represent the Contractor on the site. Directions given to the superintendent by the Owner's Authorized Representative shall be confirmed in writing to the Contractor.

#### **B.7 INSPECTION**

B.7.1 Owner's Authorized Representative shall have access to the Work at all times.

B.7.2 Inspection of the Work will be made by the Owner's Authorized Representative at its discretion. The Owner's Authorized Representative will have authority to reject Work that does not conform to the Contract Documents. Any Work found to be not in conformance with the Contract Documents, in the discretion of the Owner's Authorized Representative, shall be removed and replaced at the Contractor's expense.

B.7.3 Contractor shall make or obtain at the appropriate time all tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work. The Contractor shall give the Owner's Authorized Representative timely notice of when and where tests and inspections are to be made so that the Owner's Authorized Representative may be present for such procedures. Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Owner's Authorized Representative.

B.7.4 As required by the Contract Documents, Work done or material used without inspection or testing by the Owner's Authorized Representative may be ordered removed at the Contractor's expense.

B.7.5 If directed to do so any time before the Work is accepted, the Contractor shall uncover portions of the completed Work for inspection. After inspection, the Contractor shall restore such portions of Work to the standard required

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by the Contract. If the Work uncovered is unacceptable or was done without sufficient notice to the Owner's Authorized Representative, the uncovering and restoration shall be done at the Contractor's expense. If the Work uncovered is acceptable and was done with sufficient notice to the Owner's Authorized Representative, the uncovering and restoration will be paid for as a Change Order.

B.7.6 If any testing or inspection reveals failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Owner's Authorized Representative's and Architect/Engineer's services and expenses, shall be at the Contractor's expense.

B.7.7 When the United States government participates in the cost of the Work, or the Owner has an agreement with other public or private organizations, or if any portion of the Work is being performed for a third party or in close proximity to third party facilities, representatives of these organizations have the right to inspect the Work affecting their interests or property. Their right to inspect shall not make them a party to the Contract and shall not interfere with the rights of the parties of the Contract. Instructions or orders of such parties shall be transmitted to the Contractor, through the Owner's Authorized Representative.

#### **B.8 SEVERABILITY**

If any provision of this Contract is declared by a court to be illegal or in conflict with any law, the validity of the remaining terms and provisions shall not be affected and the rights and obligations of the parties shall be construed and enforced as if the Contract did not contain the particular provision held to be invalid.

#### **B.9 ACCESS TO RECORDS**

B.9.1 Contractor shall keep, at all times on the Work site, one record copy of the complete

Contract Documents, including the Plans, Specifications, Change Orders and addenda, in good order and marked currently to record field changes and selections made during construction, and one record copy of Shop Drawings, Product Data, Samples and similar submittals, and shall at all times give the Owner's Authorized Representative access thereto.

B.9.2 Contractor shall retain and the Owner and its duly authorized representatives shall have access to, for a period not less than six (6) years, all Record Documents, financial and accounting records, and other books, documents, papers and records of Contractor which are pertinent to the Contract including records pertaining to Overhead and indirect costs, for the purpose of making audit, examination, excerpts and transcripts. If for any reason, any part of the Contract is involved in litigation, Contractor shall retain all such records until all litigation is resolved. The Owner and/or its agents shall continue to be provided full access to the records during litigation.

#### **B.10 WAIVER**

Failure of the Owner to enforce any provision of this Contract shall not constitute a waiver or relinquishment by the Owner of the right to such performance in the future nor of the right to enforce any other provision of this Contract.

#### **B.11 SUBCONTRACTS AND ASSIGNMENT**

B.11.1 Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound by the terms and conditions of these General Conditions, and to assume toward the Contractor all of the obligations and responsibilities which the Contractor assumes toward the Owner thereunder, unless (1) the same are clearly inapplicable to the subcontract at issue because of legal requirements or industry practices, or (2) specific exceptions are requested by Contractor and approved in writing by Owner. Where appropriate, Contractor shall require each Subcontractor to enter into similar agreements with sub-subcontractors at any level.

B.11.2 At Owner's request, Contractor shall submit to Owner prior to their execution either Contractor's form of subcontract, or the subcontract to be executed with any particular Subcontractor. If Owner disapproves such form, Contractor shall not execute the form until the matters disapproved are resolved to Owner's satisfaction. Owner's review, comment upon or approval of any such form shall not relieve Contractor of its obligations under this Agreement or be deemed a waiver of such obligations of Contractor.

B.11.3 Contractor shall not assign, sell, or transfer its rights, or delegate its responsibilities under this Contract, in whole or in part, without the prior written approval of the Owner. No such written approval shall relieve Contractor of any obligations of this Contract, and any transferee shall be considered the agent of the Contractor and bound to perform in accordance with the Contract Documents. Contractor shall remain liable as between the original parties to the Contract as if no assignment had occurred.

# **B.12 SUCCESSORS IN INTEREST**

The provisions of this Contract shall be binding upon and shall accrue to the benefit of the parties to the Contract and their respective permitted successors and assigns.

# B.13 OWNER'S RIGHT TO DO WORK

Owner reserves the right to perform other or additional work at or near the project site with other forces than those of the Contractor. If such work takes place within or next to the project site, Contractor will coordinate work with the other contractors or forces, cooperate with all other contractors or forces, carry out the Work in a way that will minimize interference and delay for all forces involved, place and dispose of materials being used so as not to interfere with the operations of another, and join the Work with the work of the others in an acceptable

manner and perform it in proper sequence to that of the others. The Owner's Authorized Representative will resolve any disagreements that may arise between or among Contractor and the other contractors over the method or order of doing all work (including the Work). In case of unavoidable interference, the Owner's Authorized Representative will establish work priority (including the Work) which generally will be in the sequence that the contracts were awarded.

#### **B.14 OTHER CONTRACTS**

In all cases and at any time, the Owner has the right to execute other contracts related to or unrelated to the Work of this Contract. The Contractor of this Contract will fully cooperate with any and all other contractors without additional cost to the Owner in the manner described in Section B.13.

### **B.15 GOVERNING LAW**

This Contract shall be governed by and construed in accordance with the laws of the State of Oregon without regard to principles of conflict of laws.

#### **B.16 LITIGATION**

Any Claim between Owner and Contractor that arises from or relates to this Contract and that is not resolved through the Claims Review Process in Section D.3 shall be brought and conducted solely and exclusively within the Circuit Court of Lane County for the State of Oregon; provided, however, if a Claim must be brought in a federal forum, then it shall be brought and conducted solely and exclusively within the United States District Court for the District of Oregon. In no event shall this section be construed as a waiver by Fern Ridge School District 28J on any form of defense or immunity, whether sovereign immunity, governmental immunity, immunity based on the Eleventh Amendment to the Constitution of the United States or otherwise, from any claim or from the jurisdiction of any court. CONTRACTOR BY

### **B.17 ALLOWANCES**

B.17.1 The Contractor shall include in the Contract Price all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct.

B.17.2 Unless otherwise provided in the Contract Documents:

(a) When finally reconciled, allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

(b) Contractor's costs for unloading and handling at the site, labor, installation costs, Overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Price but not in the allowances;

(c) Whenever costs are more than or less than allowances, the Contract Price shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (i) the difference between actual costs and the allowances under Section B.17.2(a) and (2) changes in Contractor's costs under Section B.17.2(b).

(d) Unless Owner requests otherwise, Contractor shall provide to Owner a proposed fixed price for any allowance work prior to its performance.

# B.18 SUBMITTALS, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

B.18.1 The Contractor shall prepare and keep current, for the Architect's/Engineer's approval (or for the approval of Owner's Authorized Representative if approval authority has not been delegated to the Architect/Engineer), a schedule and list of submittals which is coordinated with the Contractor's construction

schedule and allows the Architect/Engineer reasonable time to review submittals. Owner reserves the right to finally approve the schedule and list of submittals. Submittals include, without limitation, Shop Drawings, Product Data, and Samples which are described below:

(a) Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor (including any sub-subcontractor), manufacturer, supplier or distributor to illustrate some portion of the Work.

(b) Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

(c) Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

B.18.2 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required by the Contract Documents the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review of submittals by the Architect/Engineer is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, or for approval of safety precautions or, unless otherwise specifically stated by the Architect/Engineer, of any construction means, methods, techniques, sequences or procedures, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect/Engineer's review of the Contractor's submittals shall not relieve the

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Contractor of its obligations under the Contract Documents. The Architect/Engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component. Informational submittals upon which the Architect/Engineer is not expected to take responsive action may be so identified in the Contract Documents. Submittals which are not required by the Contract Documents may be returned by the Architect/Engineer without action.

B.18.3 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect/Engineer Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Submittals which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor may be returned by the Architect/Engineer without action.

B.18.4 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

B.18.5 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect/Engineer.

B.18.6 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract

Documents by the Architect/Engineer's review or approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect/Engineer in writing of such deviation at the time of submittal and (i) the Architect/Engineer has given written approval to the specific deviation as a minor change in the Work, or (ii) a Change Order has been executed by Owner authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect/Engineer's review or approval thereof.

B.18.7 In the event that Owner elects not to have the obligations and duties described under this Section B.18 performed by the Architect/Engineer, or in the event no Architect/Engineer is employed by Owner on the project, all obligations and duties assigned to the Architect/Engineer hereunder shall be performed by the Owner's Authorized Representative.

#### **B.19 SUBSTITUTIONS**

The Contractor may make Substitutions only with the consent of the Owner, after evaluation by the Owner's Authorized Representative and only in accordance with a Change Order. Substitutions shall be subject to the requirements of the bid documents. By making requests for Substitutions, the Contractor represents that the Contractor has personally investigated the proposed substitute product; represents that the Contractor will provide the same warranty for the Substitution that the Contractor would for the product originally specified unless approved otherwise; certifies that the cost data presented is complete and includes all related costs under this Contract including redesign costs, and waives all claims for additional costs related to the Substitution which subsequently become apparent; and will coordinate the installation of the accepted Substitution, making such changes

#### **B.20 USE OF PLANS AND SPECIFICATIONS**

Plans, Specifications and related Contract Documents furnished to Contractor by Owner or Owner's Architect/Engineer shall be used solely for the performance of the Work under this Contract. Contractor and its Subcontractors and suppliers are authorized to use and reproduce applicable portions of such documents appropriate to the execution of the Work, but shall not claim any ownership or other interest in them beyond the scope of this Contract, and no such interest shall attach. Unless otherwise indicated, all common law, statutory and other reserved rights, in addition to copyrights, are retained by Owner.

# B.21 FUNDS AVAILABLE AND AUTHORIZED

Owner reasonably believes at the time of entering into this Contract that sufficient funds are available and authorized for expenditure to finance the cost of this Contract within the Owner's appropriation or limitation. Contractor understands and agrees that, to the extent that sufficient funds are not available and authorized for expenditure to finance the cost of this Contract, Owner's payment of amounts under this Contract attributable to Services performed after the last day of the current biennium is contingent on Owner receiving from the Oregon Legislative Assembly appropriations, limitations or other expenditure authority sufficient to allow Owner, in the exercise of its reasonable administrative discretion, to continue to make payments under this Contract.

### **B.22 NO THIRD PARTY BENEFICIARIES**

Owner and Contractor are the only parties to this Contract and are the only parties entitled to enforce its terms. Nothing in this Contract gives, is intended to give, or shall be construed to give or provide any benefit or right, whether directly, indirectly, or otherwise, to third persons unless ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON such third persons are individually identified by name herein and expressly described as intended beneficiaries of the terms of this Contract.

#### SECTION C WAGES AND LABOR

# C.1 MINIMUM WAGE RATES ON PUBLIC WORKS

Contractor shall comply fully with the provisions of ORS 279C.800 through 279C.870. Documents establishing those conditions, as determined by the Commissioner of the Bureau of Labor and Industries (BOLI), are included as attachments to the Contract Documents.

#### C.2 PAYROLL CERTIFICATION AND FEE REQUIREMENTS

C.2.1 In accordance with ORS 279C.845, the Contractor and every Subcontractor shall submit written certified statements to the Owner's Authorized Representative, on the form prescribed by the Commissioner of the Bureau of Labor and Industries, certifying the hourly rate of wage paid each worker which the Contractor or the Subcontractor has employed on the project and further certifying that no worker employed on the project has been paid less than the prevailing rate of wage or less than the minimum hourly rate of wage specified in the Contract, which certificate and statement shall be verified by the oath of the Contractor or the Subcontractor that the Contractor or Subcontractor has read such statement and certificate and knows the contents thereof and that the same is true to the Contractor or Subcontractor's best knowledge and belief. The certified statements shall set out accurately and completely the payroll records for the prior week including the name and address of each worker, the worker's correct classification, rate of pay, daily and weekly number of hours worked, deductions made and actual wages paid. Certified statements for each week during which the Contractor or Subcontractor has employed a worker on the project shall be submitted once a

month. The Contractor and Subcontractors shall

preserve the certified statements for a period of six (6) years from the date of completion of the Contract.

# C.3 PROMPT PAYMENT AND CONTRACT CONDITIONS

C.3.1 Pursuant to ORS 279C.505 and as a condition to Owner's performance hereunder, the Contractor shall:

C.3.1.1 Make payment promptly, as due, to all persons supplying to Contractor labor or materials for the prosecution of the Work provided for in this Contract.

C.3.1.2 Pay all contributions or amounts due the State Industrial Accident Fund from such Contractor or Subcontractor incurred in the performance of the Contract.

C.3.1.3 Not permit any lien or claim to be filed or prosecuted against the Owner on account of any labor or material furnished. Contractor will not assign any claims that Contractor has against Owner, or assign any sums due by Owner, to Subcontractors, suppliers, or manufacturers, and will not make any agreement or act in any way to give Subcontractors a claim or standing to make a claim against the Owner.

C.3.1.4 Pay to the Department of Revenue all sums withheld from employees pursuant to ORS 316.167.

C.3.1.5 Demonstrate that an employee drug testing program is in place as follows:

(a) Contractor represents and warrants that Contractor has in place at the time of the execution of this Contract, and shall maintain during the term of this Contract, a Qualifying Employee Drug Testing Program for its employees that includes, at a minimum, the following:

(1) A written employee drug testing policy,

(2) Required drug testing for all new Subject Employees or, alternatively, required testing of all Subject Employees every 12 months on a random selection basis, and

(3) Required testing of a Subject Employee when the Contractor has reasonable cause to believe the Subject Employee is under the influence of drugs.

A drug testing program that meets the above requirements will be deemed a "Qualifying Employee Drug Testing Program." For the purposes of this section, an employee is a "Subject Employee" only if that employee will be working on the project job site.

(b) Contractor shall require each Subcontractor providing labor for the project to:

(1) Demonstrate to the Contractor that it has a Qualifying Employee Drug Testing Program for the Subcontractor's Subject Employees, and represent and warrant to the Contractor that the Qualifying Employee Drug Testing Program is in place at the time of subcontract execution and will continue in full force and effect for the duration of the subcontract, or

(2) Require that the Subcontractor's Subject Employees participate in the Contractor's Qualifying Employee Drug Testing Program for the duration of the subcontract.

C.3.2 Pursuant to ORS 279C.515, and as a condition to Owner's performance hereunder, Contractor agrees:

C.3.2.1 If Contractor fails, neglects or refuses to make prompt payment of any claim for labor or services furnished to the Contractor or a Subcontractor by any person in connection with the project as such claim becomes due, the proper officer(s) representing the Owner may pay the claim and charge the amount of the payment against funds due or to become due Contractor under this Contract. Payment of claims in this manner shall not relieve the Contractor or the Contractor's surety from obligation with respect to any unpaid claims.

C.3.2.2 If the Contractor or a first-tier Subcontractor fails, neglects or refuses to make payment to a person furnishing labor or materials in connection with the public contract for a public improvement within thirty (30) Days after receipt of payment from Owner or a contractor, the contractor or first-tier Subcontractor shall owe the person the amount due plus interest charges commencing at the end of the 10-Day period that payment is due under ORS 279C.580(3) and ending upon final payment, unless payment is subject to a good faith dispute as defined in ORS 279C.580. The rate of interest charged to the Contractor or firsttier Subcontractor on the amount due shall equal three times the discount rate on 90-Day commercial paper in effect at the Federal Reserve Bank in the Federal Reserve district that includes Oregon on the date that is thirty (30) Days after the date when payment was received from Owner or from the Contractor, but the rate of interest shall not exceed thirty (30) percent. The amount of interest may not be waived.

C.3.2.3 If the Contractor or a Subcontractor fails, neglects or refuses to make payment to a person furnishing labor or materials in connection with the Contract, the person may file a complaint with the Construction Contractors Board, unless payment is subject to a good faith dispute as defined in ORS 279C.580. Every contract related to this Contract shall contain a similar clause.

C.3.3 Pursuant to ORS 279C.580, Contractor shall include in each subcontract for property or services entered into by the Contractor and a first-tier Subcontractor, including a material supplier, for the purpose of performing a construction contract:

(a) A payment clause that obligates the Contractor to pay the first-tier Subcontractor for satisfactory performance under its subcontract within ten (10) Days out of such amounts as are ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON paid to the Contractor by Owner under the Contract;

(b) An interest penalty clause that obligates the Contractor if payment is not made within thirty (30) Days after receipt of payment from Owner, to pay to the first-tier Subcontractor an interest penalty on amounts due in the case of each payment not made in accordance with the payment clause included in the subcontract pursuant to paragraph (a) of this subsection. Contractor or first-tier Subcontractor shall not be obligated to pay an interest penalty if the only reason that the Contractor or first-tier Subcontractor did not make payment when payment was due is that the Contractor or firsttier Subcontractor did not receive payment from Owner or Contractor when payment was due. The interest penalty shall be for the period beginning on the day after the required payment date and ending on the date on which payment of the amount due is made: and shall be computed at the rate specified in ORS 279C.515(2).

(c) A clause which requires each of Contractor's Subcontractor's to include, in each of their contracts with lower-tier Subcontractors or suppliers, provisions to the effect that the firsttier Subcontractor shall pay its lower-tier Subcontractors and suppliers in accordance with the provisions of subsections (a) and (b), above and requiring each of their Subcontractors and suppliers to include such clauses in their subcontracts and supply contracts.

C.3.4 All employers, including Contractor, that employ subject workers who work under this contract in the State of Oregon shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. Contractor shall ensure that each of its Subcontractors complies with these requirements.

#### C.4 PAYMENT FOR MEDICAL CARE

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Pursuant to ORS 279C.530, and as a condition to Owner's performance hereunder, Contractor shall promptly, as due, make payment to any person, partnership, association or corporation furnishing medical, surgical, and hospital care or other needed care and attention, incident to sickness or injury, to the employees of such Contractor, all sums of which the Contractor agrees to pay for such services and all moneys and sums which the Contractor has collected or deducted from the wages of personnel pursuant to any law, contract or agreement for the purpose of providing or paying for such services.

#### C.5 HOURS OF LABOR

As a condition to Owner's performance hereunder, Contractor shall comply with ORS 279C.520, as amended from time to time and incorporated herein by this reference:

Pursuant to ORS 279C.520 and as a condition to Owner's performance hereunder, no person shall be employed to perform Work under this Contract for more than ten (10) hours in any one day or forty (40) hours in any one week, except in cases of necessity, emergency or where public policy absolutely requires it. In such instances, Contractor shall pay the employee at least time and a half pay:

(a) For all overtime in excess of eight (8) hours a day or forty (40) hours in any one week when the work week is five consecutive Days,Monday through Friday; or

(b) For all overtime in excess of ten (10) hours a day or forty (40) hours in any one week when the work week is four consecutive Days,Monday through Friday; and

(c) For all Work performed on Saturday and on any legal holiday specified in ORS 279C.540.

This section C.5 will not apply to Contractor's Work under this Contract if Contractor is currently a party to a collective bargaining agreement with any labor organization. ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON This Section C.5 shall not excuse Contractor from completion of the Work within the time required under this Contract.

### SECTION D CHANGES IN THE WORK

# D.1 CHANGES IN WORK

D.1.1 The terms of this Contract shall not be waived, altered, modified, supplemented or amended in any manner whatsoever without prior written approval of the Owner's Authorized Representative, and then only in a manner consistent with the Change Order provisions of this Section D.1 and after any necessary approvals required by public contracting laws have been obtained. Otherwise, a formal contract amendment is required, which shall not be effective until its execution by the parties to this Contract and all approvals required by public contracting laws have been obtained.

D.1.2 It is mutually agreed that changes in Plans, quantities, or details of construction are inherent in the nature of construction and may be necessary or desirable during the course of construction. Within the general scope of this Contract, the Owner's Authorized Representative may at any time, without notice to the sureties and without impairing the Contract, require changes consistent with this Section D.1. All Change Order Work shall be executed under the conditions of the Contract Documents. Such changes may include, but are not limited to:

- (a) Modification of specifications and design.
- (b) Increases or decreases in quantities.

(c) Increases or decreases to the amount of Work.

- (d) Addition or elimination of any Work item.
- (e) Change in the duration of the project.

(f) Acceleration or delay in performance of Work.

(g) Deductive changes.

Deductive changes are those that reduce the scope of the Work, and shall be made by mutual agreement whenever feasible. In cases of suspension or partial termination under Section J, Owner reserves the right to unilaterally impose a deductive change and to self perform such Work, for which the provisions of B.13 (Owner's Right to Do Work) shall then apply.

Adjustments in compensation shall be made under the provisions of D.1.3, in which costs for deductive changes shall be based upon the percentages for labor, equipment, material and Subcontractor mark-ups specified therein, unless otherwise agreed to by Owner.

D.1.3 The Owner and Contractor agree that Change Order Work shall be administered and compensated according to the following:

(a) Unit pricing may be utilized at the Owner's option when unit prices or solicitation alternates were provided that established the cost for additional Work, and a binding obligation exists under the Contract on the parties covering the terms and conditions of the additional Work.

(b) If the Owner elects not to utilize unit pricing, or in the event that unit pricing is not available or appropriate, fixed pricing may be used for Change Order Work. In fixed pricing the basis of payments or total price shall be agreed upon in writing between the parties to the Contract, and shall be established before the Work is done whenever feasible. The mark-ups set forth in D.1.3(c) shall be utilized by the parties as a guide in establishing fixed pricing, and will not be exceeded by Owner without adequate justification. Cost and price data relating to Change Orders shall be supplied by Contractor to Owner upon request, but Owner shall be under no obligation to make such requests.

(c) In the event that unit pricing and fixed pricing are not utilized, then Change Order Work shall be performed on a cost reimbursement basis for Direct Costs. Such

Work shall be compensated on the basis of the actual, reasonable and allowable cost of labor, equipment, and material furnished on the Work performed. Labor rates shall not exceed contract BOLI labor rate plus fringe plus contractor proven burden. In addition, the following markups shall be added to the Contractor's or Subcontractor's Direct Costs as full compensation for profit, Overhead and other indirect costs for Work directly performed with the Contractor's or Subcontractor's own forces:

On Labor..... 12%

On Equipment...... 8%

On Materials..... 8%

When Change Order Work under D.1.3(c) is invoiced by an authorized Subcontractor at any level, each ascending tier Subcontractor or Contractor will be allowed a supplemental markup on each piece of subcontract Work covered by such Change Order as follows:

\$0.00 - \$5,000.00 10%, and then

Over \$5,000.00 5%

Payments made to the Contractor shall be complete compensation for Overhead, profit, and all costs that were incurred by the Contractor or by other forces furnished by the Contractor, including Subcontractors, for Change Order Work. Owner may establish a maximum cost for Change Order Work under this Section D.1.3(c), which shall not be exceeded for reimbursement without additional written authorization from Owner. Contractor shall not be required to complete such Change Order Work without additional authorization.

D.1.4 Any necessary adjustment of Contract Time that may be required as a result of a Change Order must be agreed upon by the parties before the start of the Change Order Work unless Owner's Authorized Representative authorizes Contractor to start the Work before agreement on Contract Time adjustment. Contractor shall submit any request

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for additional compensation (and additional Contract Time if Contractor was authorized to start Work before an adjustment of Contract Time was approved) as soon as possible but no later than thirty (30) Days after receipt of the Change Order. If Contractor's request for additional compensation or adjustment of Contract Time is not made within the thirty (30) day time limit, Contractor's requests pertaining to that Change Order are barred. The thirty (30) day time limit for making requests shall not be extended for any reason, including without limitation Contractor's claimed inability to determine the amount of additional compensation or adjustment of Contract Time, unless an extension is granted in writing by Owner. If Contractor and Owner's Authorized Representative cannot agree on additional compensation or additional Contract Time needed to perform Change Order Work, Contractor may proceed to file a Claim under Section D.3, Claims Review Process. No other reimbursement, compensation, or payment will be made, except as provided in Section D.1.5 for impact claims.

D.1.5 If any Change Order Work under Section D.1.3 causes an increase or decrease in the Contractor's cost of, or the Contract Time required for the performance of, any other part of the Work under this Contract, the Contractor must submit a written request to the Owner's Authorized Representative, setting forth the nature and specific extent of the request, including all time and cost impacts against the Contract as soon as possible, but no later than thirty (30) Days after receipt of the Change Order by Contractor.

The thirty (30) day time limit applies to claims of Subcontractors, suppliers, or manufacturers that may be affected by the Change Order and that request additional compensation or an extension of Contract Time to perform; Contractor has responsibility for contacting its Subcontractors, suppliers, or manufacturers within the thirty (30) day time limit, and including their requests with Contractor's

requests. If the request involves Work to be completed by Subcontractors, or materials to be furnished by suppliers or manufacturers, such requests shall be submitted to the Contractor in writing with full analysis and justification for the compensation and additional Contract Time requested. The Contractor will analyze and evaluate the merits of the requests submitted by Subcontractors, suppliers, and manufacturers to Contractor prior to including those requests and Contractor's analysis and evaluation of those requests with Contractor's requests for additional compensation or Contract Time that Contractor submits to the Owner's Authorized Representative. Failure of Subcontractors. suppliers, manufacturers or others to submit their requests to Contractor for inclusion with Contractor's requests submitted to Owner's Authorized Representative within the time period and by the means described in this section shall constitute a waiver of these Subcontractor claims. The Owner's Authorized Representative and the Owner will not consider direct requests or claims from Subcontractors, suppliers, manufacturers or others not a party to this Contract. The consideration of such requests and claims under this section does not give any person, not a party to the Contract the right to bring a claim against the Owner, whether in this claims process, in litigation, or in any dispute resolution process.

If the Contractor does not concur with the decision of the Owner's Authorized Representative, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process.

D.1.6 No request or Claim by the Contractor for additional costs or an extension of Contract Time shall be allowed if made after receipt of final payment application under this Contract. Contractor agrees to submit its final payment application within ninety (90) days after Substantial Completion, unless written extension is granted by Owner. Contractor shall not delay final payment application for any reason, including without limitation nonpayment of

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Subcontractors, suppliers, manufacturers or others not a party to this Contract, or lack of resolution of a dispute with Owner or any other person of matters arising out of or relating to the Contract. If Contractor fails to submit its final payment application within ninety (90) days after Substantial Completion, and Contractor has not obtained written extension by Owner, all requests or Claims for additional costs or an extension of Contract Time shall be waived.

D.1.7 It is understood that changes in the Work are inherent in construction of this type. The number of changes, the scope of those changes, and the effect they have on the progress of the original Work cannot be defined at this time. The Contractor is notified that numerous changes may be required and that there will be no compensation made to the Contractor directly related to the number of changes. Each change will be evaluated for extension of Contract Time and increase or decrease in compensation based on its own merit.

#### D.2 DELAYS

D.2.1 Delays in construction include "Avoidable Delays", which are defined in Section D.2.1.1, and "Unavoidable Delays", which are defined in Section D.2.1.2. The effect of Avoidable Delays is described in Section D.2.2 and the effect of Unavoidable Delays is described in Section D.2.3.

D.2.1.1 Avoidable Delays include any delays other than Unavoidable Delays, and include delays that otherwise would be considered Unavoidable Delays but that:

(a) Could have been avoided by the exercise of care, prudence, foresight, and diligence on the part of the Contractor or its Subcontractors.

(b) Affect only a portion of the Work and do not necessarily prevent or delay the prosecution of other parts of the Work nor the completion of the whole Work within the Contract Time.

(c) Do not impact activities on the accepted critical path schedule.

(d) Are associated with the reasonable interference of other contractors employed by the Owner that do not necessarily prevent the completion of the whole Work within the Contract Time.

D.2.1.2 Unavoidable Delays include delays other than Avoidable Delays that are:

(a) Caused by any actions of the Owner, Owner's Authorized Representative, or any other employee or agent of the Owner, or by separate contractor employed by the Owner.

(b) Caused by any site conditions which differ materially from what was represented in the Contract Documents or from conditions that would normally be expected to exist and be inherent to the construction activities defined in the Contract Documents. The Contractor shall notify the Owner's Authorized Representative immediately of differing site conditions before the area has been disturbed. The Owner's Authorized Representative will investigate the area and make a determination as to whether or not the conditions differ materially from either the conditions stated in the Contract Documents or those which could reasonably be expected in execution of this particular Contract. If Contractor and the Owner's Authorized Representative agree that a differing site condition exists, any additional compensation or additional Contract Time will be determined based on the process set forth in Section D.1.5 for Change Order Work. If the Contractor does not concur with the decision of the Owner's Authorized Representative and/or believes that it is entitled to additional compensation or Contract Time, or both, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process.

(c) Caused by Force Majeure acts, events or occurrences that could not have been avoided by the exercise of care, prudence, foresight, and diligence on the part of the Contractor or its Subcontractors.

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(d) Caused by adverse weather conditions. Any adverse weather conditions must be substantiated by documentary evidence that weather conditions were abnormal for the specific time period claimed, could not have been anticipated by the Contractor, and adversely impacted the project in a manner that could not be avoided by rescheduling the Work or by implementing measures to protect against the weather so that the Work could proceed. A rain, windstorm, high water, or other natural phenomenon for the specific locality of the Work, which might reasonably have been anticipated from the previous 10-year historical records of the general locality of the Work, shall not be construed as abnormal. The parties agree that rainfall greater than the following levels cannot be reasonably anticipated:

(i) Daily rainfall equal to, or greater than, 0.50 inch during a month when the monthly rainfall exceeds the normal monthly average by twenty-five percent (25 %) or more.

(ii) daily rainfall equal to, or greater than, 0.75 inch at any time.

The Office of the Environmental Data Service of the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce nearest the project site shall be considered the official agency of record for weather information.

D.2.2 Except as otherwise provided in ORS 279C.315, Contractor shall not be entitled to additional compensation or additional Contract Time for Avoidable Delays.

D.2.3 In the event of Unavoidable Delays, based on principles of equitable adjustment, Contractor may be entitled to the following:

(a) Contractor may be entitled to additional compensation or additional Contract Time, or both, for Unavoidable Delays described in Section D.2.1.2 (a) and (b).

#### ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON (b) Contractor may be entitled to additional Contract Time for Unavoidable Delays described in Section D.2.1.2(c) and (d).

In the event of any requests for additional compensation or additional Contract Time, or both, as applicable, arising under this Section D.2.3 for Unavoidable Delays, other than requests for additional compensation or additional Contract Time for differing site conditions for which a review process is established under Section D.2.1.2 (b), Contractor shall submit a written notification of the delay to the Owner's Authorized Representative within two (2) Days of the occurrence of the cause of the delay. This written notification shall state the cause of the potential delay, the project components impacted by the delay, and the anticipated additional Contract Time or the additional compensation, or both, as applicable, resulting from the delay. Within seven (7) Days after the cause of the delay has been mitigated, or in no case more than thirty (30) Days after the initial written notification, the Contractor shall submit to the Owner's Authorized Representative, a complete and detailed request for additional compensation or additional Contract Time, or both, as applicable, resulting from the delay. If the Contractor does not concur with the decision of the Owner's Authorized Representative and/or believes that it is entitled to additional compensation, or additional Contract Time, or both, as applicable, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process. If Contractor does not timely submit the notices required under this Section D.2.1.3(b), then unless otherwise prohibited by law, Contractor's Claim shall be barred.

#### D.3 CLAIMS REVIEW PROCESS

D.3.1 All Contractor Claims shall be referred to the Owner's Authorized Representative for review. Contractor's Claims, including Claims for additional compensation or additional Contract Time, shall be submitted in writing by Contractor to the Owner's Authorized

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Representative within five (5) Days after Contractor's initial request has been denied. Within thirty (30) Days after the initial Claim, Contractor shall submit to the Owner's Authorized Representative, a complete and detailed description of the Claim (the "Detailed Notice") that includes all information required by Section D.3.2. Unless the Claim is made in accordance with these time requirements, it shall be waived.

D.3.2 The Detailed Notice of the Claim shall be submitted in writing by Contractor and shall include a detailed, factual statement of the basis of the Claim, pertinent dates, Contract provisions which support or allow the Claim, reference to or copies of any documents which support the Claim, the dollar value of the Claim, and the Contract Time extension requested for the Claim. If the Claim involves Work to be completed by Subcontractors, the Contractor will analyze and evaluate the merits of the Subcontractor claim prior to forwarding it and that analysis and evaluation to the Owner's Authorized Representative. The Owner's Authorized Representative and the Owner will not consider direct claims from Subcontractors, suppliers, manufacturers, or others not a party to this Contract. Contractor agrees that it will make no agreement, covenant, or assignment, nor will it commit any other act that will permit or assist any Subcontractor, supplier, manufacturer, or other to directly or indirectly make a claim against Owner.

D.3.3 The Owner's Authorized Representative will review all Claims and take one or more of the following preliminary actions within ten (10) Days of receipt of the Detailed Notice of a Claim: (1) request additional supporting information from the Contractor; (2) inform the Contractor and Owner in writing of the time required for adequate review and response; (3) reject the Claim in whole or in part and identify the reasons for rejection; (4) based on principles of equitable adjustment, recommend approval of all or part of the Claim; or (5) propose an alternate resolution.

D.3.4 The Owner's Authorized Representative's decision shall be final and binding on the Contractor unless appealed by written notice to the Owner within fifteen (15) Days of receipt of the decision. The Contractor must present written documentation supporting the Claim within fifteen (15) Days of the notice of appeal. After receiving the appeal documentation, the Owner shall review the materials and render a decision within thirty (30) Days after receiving the appeal documents.

D.3.5 The decision of the Owner shall be final and binding unless the Contractor delivers to the Owner its requests for mediation, which shall be a non-binding process, within fifteen (15) Days of the date of the Owner's decision. The mediation process will be considered to have commenced as of the date the Contractor delivers the request. Both parties acknowledge and agree that participation in mediation is a prerequisite to commencement of litigation of any disputes relating to the Contract. Both parties further agree to exercise their best efforts in good faith to resolve all disputes within sixty (60) Days of the commencement of the mediation through the mediation process set forth herein.

In the event that a lawsuit must be filed within this sixty (60) day period in order to preserve a cause of action, the parties agree that notwithstanding the filing, they shall proceed diligently with the mediation to its conclusion prior to actively prosecuting the lawsuit, and shall seek from the Court in which the lawsuit is pending such stays or extensions, including the filing of an answer, as may be necessary to facilitate the mediation process. Further, in the event settlements are reached on any issues through mediation, the parties agree to promptly submit the appropriate motions and orders documenting the settlement to the Court for its signature and filing.

D.3.6 The mediator shall be an individual mutually acceptable to both parties, but in the absence of agreement each party shall select a

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temporary mediator and the temporary mediators shall jointly select the permanent mediator. Each party shall pay its own costs for the time and effort involved in mediation. The cost of the mediator shall be split equally between the two parties. Both parties agree to exercise their best effort in good faith to resolve all disputes in mediation. Participation in mediation is a mandatory requirement of both the Owner and the Contractor. The schedule, time and place for mediation will be mutually acceptable, or, failing mutual agreement, shall be as established by the mediator. The parties agree to comply with Owner's administrative rules governing the confidentiality of mediation, if any, and shall execute all necessary documents to give effect to such confidentiality rules. In any event, the parties shall not subpoen athe mediator or otherwise require the mediator to produce records, notes or work product, or to testify in any future proceedings as to information disclosed or representations made in the course of mediation, except to the extent disclosure is required by law.

D.3.7 Unless otherwise directed by Owner's Authorized Representative, Contractor shall proceed with the Work while any Claim of Contractor is pending, including a Claim for additional compensation or additional Contract Time resulting from Change Order Work. Regardless of the review period or the final decision of the Owner's Authorized Representative, the Contractor shall continue to diligently pursue the Work as identified in the Contract Documents. In no case is the Contractor justified or allowed to cease Work without a written stop work order from the Owner or Owner's Authorized Representative.

D.3.8 Unless otherwise directed by Owner's Authorized Representative, Contractor shall proceed with the Work. This schedule will provide a breakdown of values for the contracted Work and will be the basis for progress payments. The breakdown will demonstrate reasonable, identifiable, and measurable components of the Work. Unless objected to by

the Owner's Authorized Representative, this schedule shall be used as the basis for reviewing Contractor's applications for payment. If objected to by Owner's Authorized Representative, Contractor shall revise the schedule of values and resubmit the same for approval of Owner's Authorized Representative.

#### SECTION E PAYMENTS

#### **E.1 SCHEDULE OF VALUES**

E.1 The Contractor shall submit, at least ten (10) Days prior to submission of its first application for progress payment, a schedule of values ("Schedule of Values") for the contracted Work. This schedule will provide a breakdown of values for the contracted Work and will be the basis for progress payments. The breakdown will demonstrate reasonable, identifiable, and measurable components of the Work. Unless objected to by the Owner's Authorized Representative, this schedule shall be used as the basis for reviewing Contractor's applications for payment. If objected to by Owner's Authorized Representative, Contractor shall revise the schedule of values and resubmit the same for approval of Owner's Authorized Representative.

E.1.1 The schedule of values shall allocate at least three percent (3%) of the Contract Sum as a separate line item for that portion of the work between Substantial Completion and Final Completion, including without limitation punch list completion and furnishing of deliverables (including but not limited to approved operations and maintenance data, approved record documents, warranties and bonds, delivery of extra stock, and all other documentation or items of the work required for final completion final payment), which will be earned and paid as part of the final payment. This line item shall be entitled "Final Documentation and Punch list Completion. This percentage is not the statutory retainage described in ORS 279C.570 or any other retainage but rather requires the contractor to

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recognize that the contractor and its subcontractors will expend significant cost in advancing the work from substantial completion to final completion, and that this amount is not earned until final completion of the work is accomplished. At its sole discretion, the owner may release portions of this amount progressively as items are completed.

# E.2 APPLICATIONS FOR PAYMENT

E.2.1 Owner shall make progress payments on the Contract monthly as Work progresses. Payments shall be based upon estimates of Work completed and the Schedule of Values. All payments shall be approved by the Owner's Authorized Representative. A progress payment shall not be considered acceptance or approval of any Work or waiver of any defects therein. Owner shall pay to Contractor interest on the progress payment, not including retainage, due the Contractor. The interest shall commence thirty (30) Days after the receipt of invoice ("application for payment") from the Contractor or fifteen (15) Days after the payment is approved by the Owner's Authorized Representative, whichever is the earlier date. The rate of interest shall equal three times the discount rate on 90-day commercial paper in effect at the Federal Reserve Bank in the Federal Reserve district that includes Oregon on the date that is thirty (30) Days after receipt of the application for payment from the Contract or fifteen (15) Days after the payment is approved by the Owner, whichever is the earlier date, but the rate of interest shall not exceed thirty (30) percent. Notwithstanding the foregoing, in instances when an application for payment is filled out incorrectly, or when there is any defect or impropriety in any submitted application or when there is a good faith dispute, Owner shall so notify the Contractor within fifteen (15) Days stating the reason or reasons the application for payment is defective or improper or the reasons for the dispute. A defective or improper application for payment, if corrected by the Contractor within seven (7) Days of being notified by the Owner, shall not cause a payment

to be made later than specified in this section unless interest is also paid. Accrual of interest will be postponed when payment on the principal is delayed because of disagreement between the Owner and the Contractor.

E.2.2 Contractor shall submit to the Owner's Authorized Representative, an application for each payment and, if required, receipts or other vouchers showing payments for materials and labor, including payments to Subcontractors. Contractor shall include, in its application for payment, a schedule of the percentages of the various parts of the Work completed, based on the Schedule of Values which shall aggregate to the payment application total, and shall include, on the face of each copy thereof, a certificate in substantially the following form:

"I, the undersigned, hereby certify that the above bill is true and correct, and the payment therefore, has not been received.

,,

Signed:

E.2.3 Generally, applications for payment will be accepted only for materials that have been installed. Under special conditions, applications for payment for stored materials will be accepted at Owner's sole discretion. Such a payment, if made, will be subject to the following conditions:

(a) The request for stored material shall be submitted at least thirty (30) Days in advance of the application for payment on which it appears. Applications for payment shall be entertained for major equipment, components or expenditures only.

(b) The Contractor shall submit applications for payment showing the quantity and cost of the material stored.

(c) The material shall be stored in a bonded warehouse and Owner's Authorized Representative shall be granted the right to access the material for the purpose of removal or inspection at any time during the Contract Period.

(d) The Contractor shall name the Owner as coinsured on the insurance policy covering the full value of the property while in the care and custody of the Contractor until it is installed. A certificate noting this coverage shall be issued to the Owner.

(e) Payments shall be made for materials only. The submitted amount of the application for payment shall be reduced by the cost of transportation and for the cost of an inspector to check the delivery at out of town storage sites. The cost of said inspection shall be borne solely by the Contractor.

(f) Within sixty (60) Days of the application for payment, the Contractor shall submit evidence of payment covering the material stored.

(g) Payment for stored materials shall in no way indicate acceptance of the materials or waive any rights under this Contract for the rejection of the Work or materials not in conformance with the Contract Documents.

(h) All required documentation must be submitted with the respective application for payment.

E.2.4 The Owner reserves the right to withhold all or part of a payment, or may nullify in whole or part any payment previously made, to such extent as may be necessary in the Owner's opinion to protect the Owner from loss because of:

(a) Work that is defective and not remedied, or that has been demonstrated or identified as failing to conform with the Contract Documents,

(b) third party claims filed or evidence reasonably indicating that such claims will likely be filed unless security acceptable to the Owner is provided by the Contractor;

(c) failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment (in which case Owner may issue

checks made payable jointly to Owner and such unpaid persons under this provision, or directly to Subcontractors and suppliers at any level under Section C.3.2.1);

(d) reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Price;

(e) damage to the Owner or another contractor;

(f) reasonable evidence that the Work will not be completed within the Contract Time required by the Contract, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;

(g) failure to carry out the Work in accordance with the Contract Documents; or

(h) assessment of liquidated damages, when withholding is made for offset purposes.

E.2.5 Subject to the provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

(a) Take that portion of the Contract Price properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the total Contract Price allocated to that portion of the Work in the Schedule of Values, less retainage as provided in Section E.5. Pending final determination of cost to the Owner of changes in the Work, amounts not in the dispute may be included even though the Contract Price has not yet been adjusted by Change Order;

(b) Add that portion of the Contract Price properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner pursuant to Section E.2.3, suitably stored off the site at a location agreed upon in writing), less retainage as provided in Section E.5;

(c) Subtract the aggregate of previous payments made by the Owner; and

(d) Subtract any amounts for which the Owner's Authorized Representative has withheld or nullified payment as provided in the Contract Documents.

E.2.6 Contractor's applications for payment may not include requests for payment for portions of the Work for which the Contractor does not intend to pay to a Subcontractor or material supplier.

E.2.7 The Contractor warrants to Owner that title to all Work covered by an application for payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an application for payment all Work for which payments are received from the Owner shall be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

E.2.8 If Contractor disputes any determination by Owner's Authorized Representative with regard to any application for payment, Contractor nevertheless shall continue to prosecute expeditiously the Work. No payment made hereunder shall be or be construed to be final acceptance or approval of that portion of the Work to which such partial payment relates or shall relieve Contractor of any of its obligations hereunder.

# E.3 PAYROLL CERTIFICATION REQUIREMENT

Payroll certification is required before payments are made on the Contract. Refer to Section C.2 for this information.

E.4 NOT USED

#### E.5 RETAINAGE

E.5.1 Retainage shall be withheld and released in accordance with ORS 279C.550 to 279C.580:
E.5.1.1 Owner may reserve as retainage from any progress payment an amount not to exceed five percent of the payment. As Work progresses, Owner may reduce the amount of the retainage and may eliminate retainage on any remaining monthly Contract payments after 50 percent of the Work under the Contract is completed if, in the Owner's opinion, such Work is progressing satisfactorily. Elimination or reduction of retainage shall be allowed only upon written application by the Contractor. which application shall include written approval of Contractor's surety; except that when the Work is 97-1/2 percent completed the Owner may, at its discretion and without application by the Contractor, reduce the retained amount to 100 percent of the value of the Work remaining to be done. Upon receipt of written application by the Contractor, Owner shall respond in writing within a reasonable time.

E.5.1.2 In accordance with the provisions of ORS 279C.560 and any applicable administrative rules, Contractor may request in writing:

(a) to be paid amounts which would otherwise have been retained from progress payments where Contractor has deposited acceptable bonds and securities of equal value with Owner or in a custodial account or other mutuallyagreed account satisfactory to Owner, with an approved bank or trust company to be held in lieu of the cash retainage for the benefit of Owner;

(b) that retainage be deposited in an interest bearing account, established through the State Treasurer for state agencies, in a bank, savings bank, trust company or savings association for the benefit of Owner, with earnings from such account accruing to the Contractor; or

(c) that the Owner allow Contractor to deposit a surety bond for the benefit of Owner, in a form acceptable to Owner, in lieu of all or a portion of funds retained, or to be retained. Such bond and any proceeds therefrom shall be made subject to all claims and liens in the manner and priority as set forth for retainage under ORS 279C.550 to ORS 279C.625.

Where the Owner has accepted the Contractor's election of option (a) or (b), Owner may recover from Contractor any additional costs incurred through such election by reducing Contractor's final payment. Where the Owner has agreed to Contractor's request for option (c), Contractor shall accept like bonds from Subcontractors and suppliers on the project from which Contractor has required retainage.

E.5.1.3 The retainage held by Owner shall be included in and paid to the Contractor as part of the final payment of the Contract Price. The Owner shall pay to Contractor interest at the rate of one and one-half percent per month on the final payment due Contractor, interest to commence thirty (30) Days after the Work under the Contract has

been completed and accepted and to run until the date Contractor shall notify Owner in writing when the Contractor considers the Work complete and Owner shall, within fifteen (15) Days after receiving the written notice, either accept the Work or notify the Contractor of Work yet to be performed on the Contract. If Owner does not within the time allowed notify the Contractor of Work yet to be performed to fulfill contractual obligations, the interest provided by this subsection shall commence to run thirty (30) Days after the end of the 15-Day period.

E.5.1.4 In accordance with the provisions of ORS 279C.560, Owner shall reduce the amount of the retainage if the Contractor notifies the controller of the Owner that the Contractor has deposited in an escrow account with a bank or trust company, in a manner authorized by the Owner's Authorized Representative, bonds and securities of equal value of a kind approved by the Owner's Authorized Representative.

E.5.1.5 Contractor agrees that if Contractor elects to reserve a retainage from any progress

payment due to any Subcontractor or supplier, such retainage shall not exceed five percent of the payment, and such retainage withheld from Subcontractors and suppliers shall be subject to the same terms and conditions stated in Subsection E.5 as apply to Owner's retainage from any progress payment due to Contractor.

#### E.6 FINAL PAYMENT

E.6.1 Upon completion of all the Work under this Contract, the Contractor shall notify the Owner's Authorized Representative, in writing, that Contractor has completed Contractor's part of the Contract and shall request final payment. Upon receipt of such notice the Owner's Authorized Representative will inspect the Work, and if acceptable, submit to the Owner a recommendation as to acceptance of the completed Work and as to the final estimate of the amount due the Contractor. If the Work is not acceptable, Owner will notify Contractor within fifteen (15) Days of Contractor's request for final payment. Upon approval of this final estimate by the Owner and compliance by the Contractor with provisions in Section K. 3 AFFIDAVIT/RELEASE OF LIENS AND CLAIMS, and other provisions as may be applicable, the Owner shall pay to the Contractor all monies due under the provisions of these Contract Documents.

E.6.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Owner's Authorized Representative (1) a notarized affidavit/release of liens and claims in a form satisfactory to Owner that states that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least thirty (30) Davs' prior written notice has been

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given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

E.6.3 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final application for payment.

#### E.7 PENALTIES

E.7.1 Should the Contractor fail to substantially complete the Work on or before the date stipulated for Substantial Completion (or such later date as may result from extension of time granted by Owner), Contractor shall pay the Owner, as a penalty, the sum specified in the Contract for each consecutive calendar day that terms of the contract remain unfulfilled beyond the date allowed by the Contract, which sum is agreed upon as a reasonable and proper measure of damages which the Owner will sustain per day by failure of the Contractor to complete on schedule is uncertain and cannot be computed exactly.

E.7.2 For each consecutive calendar day that the Work remains incomplete after the date

established for Final Completion, the Owner will retain from the compensation otherwise to be paid to the Contractor the sum specified in the Contract. This amount is the minimum measure of damages the Owner will sustain by failure of the Contractor to complete all remedial work, correct deficient work, clean up and other miscellaneous tasks as required to complete all work specified. This amount is in addition to the penalty prescribed above.

E.7.3 For the purposes of penalties, the date of Final Completion shall be the date as stated in the Architect/Engineer's letter to the Owner that the Project is finally complete.

#### SECTION F JOB SITE CONDITIONS

#### F.1 USE OF PREMISES

Contractor shall confine equipment, storage of materials and operation of Work to the limits indicated by Contract Documents, law, ordinances, permits or directions of the Owner's Authorized Representative. Contractor shall follow the Owner's Authorized Representative's instructions regarding use of premises, if any.

# F.2 PROTECTION OF WORKERS, PROPERTY, AND THE PUBLIC

F.2.1 Contractor shall maintain continuous and adequate protection of all of the Work from damage, and shall protect the Owner's Authorized Representative, Owner's workers and property from injury or loss arising in connection with this Contract. Contractor shall remedy acceptably to the Owner, any damage, injury, or loss, except such as may be directly due to errors in the Contract Documents or caused by authorized representatives or personnel of the Owner. Contractor shall adequately protect adjacent property as provided by law and the Contract Documents.

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F.2.2 Contractor shall take all necessary precautions for the safety of all personnel on the job site, and shall comply with the Contract Documents and all applicable provisions of federal, state and municipal safety laws and building codes to prevent accidents or injury to persons on, about or adjacent to the premises where the Work is being performed. Contractor shall erect and properly maintain at all times, as required by the conditions and progress of the Work, all necessary safeguards for protection of workers and the public against any hazards created by construction. Contractor shall designate a responsible employee or associate on the Work site, whose duty shall be the prevention of accidents. The name and position of the person designated shall be reported to the Owner's Authorized Representative. The Owner's Authorized Representative has no responsibility for Work site safety. Work site safety is the responsibility of the Contractor.

F.2.3 Contractor shall not enter upon private property without first obtaining permission from the property

owner or its duly authorized representative. Contractor shall be responsible for the preservation of all public and private property along and adjacent to the Work contemplated under the Contract and shall use every precaution necessary to prevent damage thereto. In the event the Contractor damages any property, the Contractor shall at once notify the property owner and make, or arrange to make, full restitution. Contractor shall report, immediately in writing, to the Owner's Authorized

Representative, all pertinent facts relating to such property damage and the ultimate disposition of the claim for damage.

F.2.4 Contractor is responsible for protection of adjacent work areas including impacts brought about by activities, equipment, labor, utilities, and materials on the site.

F.2.5 Contractor shall at all times direct its activities in such a manner as to minimize adverse effects on the environment. Handling of all materials will be conducted so no release will occur that may pollute or become hazardous.

F.2.6 In an emergency affecting the safety of life or of the Work or of adjoining property, the Contractor, without special instruction or authorization from the Owner's Authorized Representative, shall act reasonably to prevent threatened loss or injury, and shall so act, without appeal, if instructed by the Owner's Authorized Representative. Any compensation claimed by the Contractor on account of emergency work shall be determined in accordance with Section D.

#### F.3 CUTTING AND PATCHING

F.3.1 Contractor shall be responsible for coordinating all cutting, fitting, or patching of the Work to make its several parts come together properly and fit to receive or be received by work of other contractors or Subcontractors shown upon, or reasonably implied by, the Contract Documents.

F.3.2 Contractor shall be responsible for restoring all cut, fitted, or patched surfaces to an original condition; provided, however, that if a different condition is specified in the Contract Documents, then Contractor shall be responsible for restoring such surfaces to the condition specified in the Contract Documents.

#### F.4 CLEANING UP

From time to time as may be ordered by the Owner the Contractor shall, at its own expense, clean up and remove all refuse and unused materials of any kind resulting from the Work. If Contractor fails to do so within twenty-four hours after notification by the Owner the work may be done by others and the cost charged to the Contractor and deducted from payment due the Contractor.

## F.5 ENVIRONMENTAL CONTAMINATION

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F.5.1 Contractor will be held responsible for and shall indemnify, defend (with counsel of Owner's choice) and hold harmless Owner from and against any costs, expenses, damages, claims, and causes of action, (including attorney fees), or any of them, resulting from all spills, releases, discharges, leaks and disposal of environmental pollution, including storage, transportation, and handling during the performance of the Contract which occur as a result of, or are contributed by, the negligence or actions of

Contractor or its personnel, agents, or Subcontractors or any failure to perform in accordance with the Contract Documents (except to the extent otherwise void under ORS 30.140). Nothing in this section F.5.1 shall limit Contractor's responsibility for obtaining insurance coverage required under Section G.3 of these General Conditions, and Contractor shall take no action that would void or impair such coverages

F.5.1.1 Contractor agrees to promptly dispose of such spills, releases, discharge or leaks to the satisfaction of Owner and proper regulatory agencies in a manner that complies with applicable federal, state, and local laws and regulations. Cleanup shall be at no cost to the Owner and be performed by properly qualified personnel.

F.5.1.2 Contractor shall obtain the Owner's written consent prior to bringing onto the Work site any (i) environmental pollutants or (ii) hazardous substances or materials, as the same or reasonably similar terms are used in any applicable federal, state, or local statutes, rules or ordinances. Notwithstanding such written consent from the Owner, the Contractor, at all times, shall:

(a) properly handle, use and dispose of all environmental pollutants and hazardous substances or materials brought onto the Work site, in accordance with all applicable federal, state, or local statutes, rules, or ordinances;

(b) be responsible for any and all spills, releases, discharges, or leaks of (or from) environmental pollutants or hazardous substances or materials which Contractor has brought onto the Work site; and

(c) promptly clean up, without cost to the Owner, such spills, releases, discharges, or leaks to the Owner's satisfaction and in compliance with all applicable federal, state, or local statutes, rules or ordinances.

F.5.2 Contractor shall report all reportable quantity releases to applicable federal, state, and local regulatory and emergency response agencies. Reportable quantities are found in 40 CFR Part 302, Table 302.4 for hazardous substances and in OAR Chapter 340 Division 108 for all products addressed therein. Upon discovery, regardless of quantity, Contractor must telephonically report all releases to the Owner. A written follow-up report shall be submitted to Owner within 48 hours of the telephonic report. Such written report shall contain, as a minimum:

(a) Description of items released (identity, quantity, manifest no., and all other documentation required by law.)

(b) Whether amount of items released is EPA/DEQ reportable, and, if so, when it was reported.

(c) Exact time and location of release, including a description of the area involved.

(d) Containment procedures initiated.

(e) Summary of communications about the release Contractor has had with members of the press or State officials other than Owner.

(f) Description of cleanup procedures employed or to be employed at the site, including disposal location of spill residue.

(g) Personnel injuries, if any, resulting from, or aggravated by, the release.

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## F.6 ENVIRONMENTAL CLEAN-UP

F.6.1 Unless disposition of environmental pollution is specifically a part of this Contract, or was caused by the Contractor (reference F.5 Environmental Contamination), Contractor shall immediately notify Owner of any hazardous substance(s) which Contractor discovers or encounters during performance of the Work required by this Contract. "Hazardous substance(s)" means any hazardous, toxic and radioactive materials and those substances defined as "hazardous substances," "hazardous materials," "hazardous wastes," "toxic substances," or other similar designations in any federal, state, or local law, regulation, or ordinance, including without limitation asbestos, polychlorinated biphenyl (PCB), or petroleum, and any substances, materials or wastes regulated in 40 CFR, Part 261 and defined as hazardous in 40 CFR S 261.3. In addition to notifying Owner of any hazardous substance(s) discovered or encountered. Contractor shall immediately cease working in any particular area of the project where a hazardous substance(s) has been discovered or encountered if continued work in such area would present a risk or danger to the health or well being of Contractor's or any Subcontractor's work force.

F.6.2 Upon being notified by Contractor of the presence of hazardous substance(s) on the project site, Owner shall arrange for the proper disposition of such hazardous substance(s).

#### F.7 FORCE MAJEURE

A party to this Contract shall not be held responsible for delay or default due to Force Majeure acts, events or occurrences unless they could have been avoided by the exercise of reasonable care, prudence, foresight, and diligence by that party. The Owner may terminate this Contract upon written notice after determining that delay or default caused by Force Majeure acts, events or occurrences will reasonably prevent successful performance of the Contract.

#### SECTION G INDEMNITY, BONDING, AND INSURANCE

# G.1 RESPONSIBILITY FOR DAMAGES / INDEMNITY

G.1.1 Contractor shall be responsible for all damage to property, injury to persons, and loss, expense, inconvenience, and delay that may be caused by, or result from, the carrying out of the Work to be done under this Contract, or from any act, omission or neglect of the Contractor, its Subcontractors, personnel, or agents.

G.1.2 To the fullest extent permitted by law, Contractor shall indemnify, defend (with counsel approved by Owner) and hold harmless the Owner, Owner's Authorized Representative, Architect/Engineer, Architect/Engineer's consultants, and their respective officers, directors, agents, employees, partners, members, stockholders and affiliated companies (collectively "Indemnitees") from and against all liabilities, damages, losses, claims, expenses (including reasonable attorney fees), demands and actions of any nature whatsoever which arise out of, result from or are related to, (a) any damage, injury, loss, expense, inconvenience or delay described in this Section G.1.2, (b) any accident or occurrence which happens or is alleged to have happened in or about the project site or any place where the Work is being performed, or in the vicinity of either, at any time prior to the time the Work is fully completed in all respects, (c) any failure of the Contractor to observe or perform any duty or obligation under the Contract Documents which is to be observed or performed by the Contractor, or any breach of any agreement, representation or warranty of the Contractor contained in the Contract Documents or in any subcontract.

(d) the negligent acts or omissions of the Contractor, a Subcontractor or anyone directly or indirectly employed by them or any one of

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them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder (except to the extent otherwise void under ORS 30.140), and (e) any lien filed upon the project or bond claim in connection with the Work. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section G.1.2.

G.1.3 In claims against any person or entity indemnified under this Section G.1.2 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section G.1.2 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

# G.2 PERFORMANCE AND PAYMENT SECURITY

G.2.1 When the Contract Price is \$100,000 or more the Contractor shall furnish and maintain in effect at all times during the Contract Period, a performance bond in a sum equal to the Contract Price, and a separate payment bond also in a sum equal to the Contract Price. The bonds may be required if the Contract Price is less than \$100,000, if required by the Contract Documents.

G.2.2 Bond forms furnished by the Owner or Contractor's Surety and notarized by awarded Contractor's surety company authorized to do business in Oregon are the only acceptable forms of performance and payment security, unless otherwise specified in the Contract Documents.

#### G.3 INSURANCE

G.3.1 Primary Coverage: Insurance carried by Contractor under this Contract shall be the primary coverage, and the Owner's insurance is excess and solely for damages or losses for which the Owner is responsible. The coverages indicated are minimums unless otherwise specified in the Contract Documents.

G.3.2 Workers' Compensation: All employers, including Contractor, that employ subject workers who work under this contract in the State of Oregon shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. This shall include Employer's Liability Insurance with coverage limits of not less than \$100,000 for each accident. Contractors who perform the Work without the assistance or labor of any employee need not obtain such coverage if the

Contractor certifies so in writing. Contractor shall ensure that each of its Subcontractors complies with these requirements. The Contractor shall require proof of such Workers' Compensation by receiving and keeping on file a certificate of insurance from each Subcontractor or anyone else directly employed by either the Contractor or its Subcontractors.

G.3.3 Builder's Risk Insurance not required:

G.3.4 Liability Insurance:

G.3.4.1 Commercial General Liability: Contractor shall obtain, at Contractor's expense, and keep in effect during the term of this Contract, Commercial General Liability Insurance covering bodily injury and property damage in a form and with coverages that are satisfactory to the Owner. This insurance shall include personal injury liability, products and completed operations, and contractual liability coverage for the indemnity provided under this Contract (to the extent contractual liability coverage for the indemnity is available in the marketplace), and shall be issued on an occurrence basis. Combined single limit per occurrence shall not be less than \$1,000,000 for

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each job site or location. Each annual aggregate limit shall not be less than \$2,000,000.

G.3.4.2 Automobile Liability: Contractor shall obtain, at Contractor's expense, and keep in effect during the term of this Contract, Automobile Liability Insurance covering owned, non-owned and/or hired vehicles, as applicable. The coverage may be written in combination with the Commercial General Liability Insurance. Combined single limit per occurrence shall not be less than \$1,000,000.00, or the equivalent.

G.3.4.3 "Tail" Coverage: If any of the required liability insurance is arranged on a "claims made" basis, "tail" coverage will be required at the completion of this Contract for a duration of 24 months or the maximum time period available in the marketplace if less than 24 months. Contractor will be responsible for furnishing certification of "tail" coverage as described or continuous "claims made" liability coverage for 24 months following Final Completion. Continuous "claims made" coverage will be acceptable in lieu of "tail" coverage, provided its retroactive date is on or before the effective date of this Contract. This will be a condition of the final acceptance of Work or services and related warranty (if any).

G.3.5 Additional Insured: The liability insurance coverage, except Professional Liability if included, required for performance of this Contract shall include the Fern Ridge School District 28J, its board, departments, employees, and volunteers as Additional Insureds but only with respect to the Contractor's activities to be performed under this Contract. If Contractor cannot obtain an insurer to name the Fern Ridge School District 28J, its board, departments, employees, and volunteers as Additional Insureds, Contractor shall obtain at Contractor's expense, and keep in effect during the term of this Contract, Owners and Contractors Protective Liability Insurance, naming the Fern Ridge School District 28J, its board, departments, employees, and volunteers as

Named Insureds with not less than a \$1,000,000.00 limit per occurrence. This policy must be kept in effect for 12 months following Final Completion. As evidence of coverage, Contractor shall furnish the actual policy to Owner prior to its issuance of a Notice to Proceed.

G.3.6 Notice of Cancellation or Change: There shall be no cancellation, material change, potential exhaustion coverages without thirty (30) Days' written notice from the Contractor or its insurer(s) to the Owner. Any failure to comply with the reporting provisions of this insurance, except for the potential exhaustion of aggregate limits, shall not affect the coverages provided to Fern Ridge School District 28J, its board, departments, employees, and volunteers.

G.3.7 Certificate(s) of Insurance: As evidence of the insurance coverage required by this Contract, the Contractor shall furnish certificate(s) of insurance to the Owner prior to its issuance of a Notice to Proceed. The certificate(s) will specify all of the parties who are Additional Insureds or Loss Payees. Insurance coverage required under this Contract shall be obtained from insurance companies or entities acceptable to the Owner that are allowed to provide such insurance under Oregon law. Eligible insurers include admitted insurers that have been issued a certificate of authority from the Oregon Department of Consumer and Business Services authorizing them to do an insurance business in the state of Oregon, and certain non-admitted surplus lines insurers that satisfy the requirements of applicable Oregon law and are approved by the Owner. The certificates will also specify that there shall be no cancellation, material change, potential exhaustion of aggregate limits or intent not to renew insurance coverages without thirty (30) Days' written notice from the insurer(s) to the Owner. To the extent Certificates of Insurance contain words to the effect that Contractor shall "endeavor to send notice of cancellation" or similar language, Contractor shall require its insurer to send such notice by making sure that the words "endeavor to" or

similar words are removed from the Certificate. The Contractor shall be financially responsible for all deductibles, self-insured retentions and/or self-insurance included hereunder. Any deductible, self-insured retention and/or selfinsurance in excess of \$50,000 shall be approved by the Owner in writing prior to issuance of a Notice to Proceed and is subject to Owner's approval.

#### SECTION H SCHEDULE OF WORK

#### H.1 CONTRACT PERIOD

H.1.1 Time is of the essence on this Contract. The Contractor shall at all times carry on the Work diligently, without delay and punctually fulfill all requirements herein. Contractor shall commence Work on the site within fifteen (15) Days of Notice to Proceed, unless directed otherwise.

H.1.2 Unless specifically extended by Change Order, all Work shall be complete by the date contained in the Contract Documents. The Owner shall have the right to accelerate the completion date of the Work, which may require the use of overtime. Such accelerated Work schedule shall be an acceleration in performance of Work under Section D.1.2 (f) and shall be subject to the Change Order process of Section D.1.

H.1.3 The Owner shall not waive any rights under the Contract by permitting the Contractor to continue or complete the Work or any part of it after the date described in Section H.1.2 above.

#### H.2 SCHEDULE

H.2.1 To ensure work is completed within the time periods stated in the bidding documents and as stated on the Notice to Proceed; the Contractor shall develop a project schedule with appropriate milestones that include substantial and final completion for Owner approval. Contractor shall provide, by or before the pre-

construction conference, a detailed schedule for review and acceptance by the Owner. The submitted schedule must illustrate Work by significant project components; significant labor trades, long lead items, milestones, and be broken down by building and/or floor where applicable. Each schedule item shall account for no greater than 5 % of the monetary value of the project or 5 % of the available Contract Time. Schedules with activities of less than one day or valued at less than 1% of the Contract will be considered too detailed and will not be accepted. Schedules lacking adequate detail, or unreasonably detailed, will be rejected. Included within the schedule are the following: Notice to Proceed, Milestones, Substantial Completion, and Final Completion. Schedules will be updated monthly and submitted with the monthly payment application. Acceptance of the Schedule by the Owner does not constitute agreement by the Owner, as to the Contractor's sequencing, means, methods, or allocated Contract Time. Any positive difference between the Contractor's scheduled completion and the Contract completion date is float owned by the Owner. Owner reserves the right to negotiate the float if it is deemed to be in Owner's best interest to do so. In no case shall the Contractor make a claim for delays if the Work is completed within the Contract Time but after Contractor's scheduled completion.

#### H.3 PARTIAL OCCUPANCY OR USE

H.3.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage, provided such occupancy or use is consented to by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have reasonably accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, insurance or self-insurance, maintenance, heat, utilities, and damage to the Work, and have agreed in writing concerning the period for correction of the Work and

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commencement of warranties required by the Contract Documents with respect to such portion of the Work. Approval by the Contractor to partial occupancy or use shall not be unreasonably withheld. Immediately prior to such partial occupancy or use, the Owner and Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

#### SECTION I CORRECTION OF WORK

#### I.1 CORRECTION OF WORK BEFORE FINAL PAYMENT

The Contractor warrants to the Owner that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects, and that the Work will conform to the requirements of the Contract Documents. Work failing to conform to these requirements shall be deemed defective. Contractor shall promptly remove from the premises and replace all defective materials and equipment as determined by the Owner's Authorized Representative, whether incorporated in the Work or not. Removal and replacement shall be without loss or expense to the Owner, and Contractor shall bear the cost of repairing all Work destroyed or damaged by such removal or replacement. Contractor shall be allowed a period of no longer than sixty (60) days for completion of defective (punch list) work, unless otherwise agreed. At the end of that period, or earlier if requested by the Contractor, Owner shall arrange for inspection of the Work by the Architect/Engineer. Should the Work not be complete, and all corrections made, the costs for all subsequent re-inspections shall be borne by

the Contractor. If Contractor fails to complete the punch list work within the above time period, without affecting Contractor's obligations Owner may perform such work and Contractor shall reimburse Owner all costs of the same within thirty (30) days after demand.

#### I.2 WARRANTY WORK

I.2.1 Neither the final certificate of payment nor any provision of the Contract Documents shall relieve the Contractor from responsibility for defective Work and, unless a longer period is specified, Contractor shall correct all defects that appear in the Work within a period of one year from the date of issuance of the written notice of substantial completion by the Owner except for latent defects which will be remedied by the Contractor at any time they become apparent.

The Owner shall give Contractor notice of defects with reasonable promptness. Contractor shall perform such warranty work within a reasonable time after Owner's demand. If Contractor fails to complete the warranty work within such period as Owner determines reasonable, or at any time in the event of warranty work consisting of emergency repairs, without affecting Contractor's obligations, Owner may perform such work and Contractor shall reimburse Owner all costs of the same within thirty (30) Days after demand.

I.2.2 This provision does not negate guarantees or warranties for periods longer than one year including without limitation such guarantees or warranties required by other sections of the Contract

Documents for specific installations, materials, processes, equipment or fixtures.

I.2.3 In addition to Contractor's warranty, manufacturer's warranties shall pass to the Owner and shall not take effect until affected Work has been accepted in writing by the Owner's Authorized Representative. I.2.4 The one-year period for correction of Work shall be extended with respect to portions of Work performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work, and shall be extended by corrective Work performed by the Contractor pursuant to this Section, as to the Work corrected. The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

I.2.5 Nothing contained in this Section I.2 shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of the period for correction of Work as described in this Section I.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

I.2.6 If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Price will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

#### SECTION J SUSPENSION AND/OR TERMINATION OF THE WORK

# J.1 OWNER'S RIGHT TO SUSPEND THE WORK

J.1.1 The Owner and/or the Owner's Authorized Representative has the authority to suspend portions or all of the Work due to the following causes:

(a) Failure of the Contractor to correct unsafe conditions;

(b) Failure of the Contractor to carry out any provision of the Contract;

(c) Failure of the Contractor to carry out orders;

(d) Conditions, in the opinion of the Owner's Authorized Representative, which are unsuitable for performing the Work;

(e) Time required to investigate differing site conditions;

(f) Any reason considered to be in the public interest.

J.1.2 The Owner shall notify Contractor and the Contractor's Surety in writing of the effective date and time of the suspension and shall notify Contractor and its surety in writing to resume Work.

#### J.2 CONTRACTOR'S RESPONSIBILITIES

J.2.1 During the period of the suspension, Contractor is responsible to continue maintenance at the project just as if the Work were in progress. This includes, but is not limited to, protection of completed Work, maintenance of access, protection of stored materials, temporary facilities, and clean-up.

J.2.2 When the Work is recommenced after the suspension, the Contractor shall replace or renew any Work damaged during the suspension, remove any materials or facilities used as part of temporary maintenance, and complete the project in every respect as though its prosecution had been continuous and without suspension.

#### J.3 COMPENSATION FOR SUSPENSION

J.3.1 Depending on the reason for suspension of the Work, the Contractor or the Owner may be

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due compensation by the other party. If the suspension was required due to acts or omissions of Contractor, the Owner may assess the Contractor actual costs of the suspension in terms of administration, remedial work by the Owner's forces or another contractor to correct the problem associated with the suspension, rent of temporary facilities, and other actual costs related to the suspension. If the suspension was caused by acts or omissions of the Owner, the Contractor shall be due compensation which shall be defined using Section D, Changes in Work. If the suspension was required through no fault of the Contractor or the Owner, neither party owes the other for the impact.

# J.4 OWNER'S RIGHT TO TERMINATE CONTRACT

J.4.1 The Owner may, without prejudice to any other right or remedy, and after giving Contractor seven (7) Days' written notice and an opportunity to cure, terminate the Contract in whole or in part under the following conditions:

(a) If Contractor should voluntarily or involuntarily, seek protection under the United States Bankruptcy Code and Contractor as debtor-in-possession or the Trustee for the estate fails to assume the Contract within a reasonable time;

(b) If Contractor should make a general assignment for the benefit of Contractor's creditors;

(c) If a receiver should be appointed on account of Contractor's insolvency;

(d) If Contractor should repeatedly refuse or fail to supply an adequate number of skilled workers or proper materials to carry on the Work as required by the Contract Documents, or otherwise fail to perform the Work in a timely manner;

(e) If Contractor should repeatedly fail to make prompt payment to Subcontractors or for material or labor, or should disregard laws, ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON ordinances or the instructions of the Owner or its Authorized Representative; or

(f) If Contractor is otherwise in material breach of any part of the Contract.

J.4.2 At any time that any of the above occurs, Owner may exercise all rights and remedies available to Owner at law or in equity, and in addition, Owner may take possession of the premises and of all materials and appliances and finish the Work by whatever method it may deem expedient. In such case, the Contractor shall not be entitled to receive further payment until the Work is completed. If the Owner's cost of finishing the Work exceeds the unpaid balance of the Contract Price, Contractor shall pay the difference to the Owner.

#### J.5 TERMINATION FOR CONVENIENCE

J.5.1 Owner may terminate the Contract in whole or in part whenever Owner determines that termination of the Contract is in the best interest of the public.

J.5.2 The Owner will provide the Contractor with seven (7) Days' prior written notice of a termination for public convenience. After such notice, the Contractor shall provide the Owner with immediate and peaceful possession of the premises and materials located on and off the premises for which the Contractor received progress payment under Section E. Compensation for Work terminated by the Owner under this provision will be according to Section E. In no circumstance shall Contractor be entitled to lost profits for Work not performed due to termination.

#### J.6 ACTION UPON TERMINATION

J.6.1 Upon receiving a notice of termination, and except as directed otherwise by the Owner, Contractor shall immediately cease placing further subcontracts or orders for materials, services, or facilities. In addition, Contractor shall terminate all subcontracts or orders to the extent they relate to the Work terminated and, with the prior written approval of the Owner, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts and orders.

J.6.2 As directed by the Owner, Contractor shall upon termination transfer title and deliver to the Owner all Record Documents, information, and other property that, if the Contract had been completed, would have been required to be furnished to the Owner.

#### SECTION K CONTRACT CLOSE OUT

#### K.1 RECORD DOCUMENTS

As a condition of final payment (refer also to section E.6), Contractor shall comply with the following: Contractor shall provide to Owner's Authorized Representative, Record Documents of the entire project including; three (3) sets of As-Built drawings, and one electronic version, two (2) original O&M Manuals and one electronic version. Record Documents shall depict the project as constructed and shall reflect each and every change, modification, and deletion made during the construction. Record Documents are part of the Work and shall be provided prior to the Owner's issuance of final payment. Record Documents include all modifications to the Contract Documents unless otherwise directed.

## K.2 OPERATION AND MAINTENANCE MANUALS

As part of the Work, Contractor shall submit two completed operation and maintenance manuals ("O & M Manuals") for review by the Owner's Authorized Representative prior to submission of any pay request for more than 75% of the Work. No payments beyond 75% will be made by the Owner until the 0 & M Manuals have been received. The O & M Manuals shall contain all product data as required by the specifications, training information, phone list of consultants, manufacturers, installer and suppliers, manufacturer's printed data, record

and shop drawings, schematic diagrams of systems, appropriate equipment indices, warranties and bonds. The Owner's Authorized Representative shall review and return one O & M Manual for any modifications or additions required. Prior to submission of its final pay request, Contractor shall deliver one electronic and two (2) original, complete and approved sets of O & M Manuals to the Owner's Authorized Representative.

# K.3 AFFIDAVIT/RELEASE OF LIENS AND CLAIMS

As a condition of final payment, the Contractor shall submit to the Owner's Authorized Representative a notarized affidavit/release of liens and claims form, in a form satisfactory to Owner, which states that all Subcontractors and suppliers have been paid in full, all disputes with property owners have been resolved, all obligations on the project have been satisfied, all monetary claims and indebtedness have been paid, and that, to the best of the Contractor's knowledge, there are no claims of any kind outstanding against the project. The Contractor shall indemnify, defend (with counsel of Owner's choice) and hold harmless the Owner from all claims for labor and materials finished under this Contract. The Contractor shall furnish complete and valid releases or waivers, satisfactory to the Owner, of all liens arising out of or filed in connection with the Work.

#### K.4 COMPLETION NOTICES

K.4.1 Contractor shall provide Owner notice of both Substantial and Final Completion. The certificate of Substantial Completion shall state the date of Substantial Completion, the responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and the time within which the Contractor shall finish all items on the punch list accompanying the Certificate. Both completion notices must be signed by the Contractor and the Owner to be valid. The Owner shall provide the final signature on the

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notices. The notices shall take effect on the date they are signed by the Owner.

K.4.2 Substantial Completion of a facility with operating systems (e.g., mechanical, electrical, HVAC) shall be that degree of completion that has provided a minimum of thirty (30) continuous Days of successful, trouble-free operation, which period shall begin after all performance and acceptance testing has been successfully demonstrated to the Owner's Authorized Representative. All equipment contained in the Work, plus all other components necessary to enable the Owner to operate the facility in the manner that was intended, shall be complete on the Substantial Completion date. The Contractor may request that a punch list be prepared by the Owner's Authorized Representative with submission of the request for the Substantial Completion notice.

#### K.5 TRAINING

As part of the Work, and prior to submission of the request for final payment, the Contractor shall schedule with the Owner's Authorized Representative, training sessions for all equipment and systems, as required in the individual specifications sections. Contractor shall schedule training sessions at least two weeks in advance of the date of training to allow Owner personnel adequate notice.

The O & M Manual shall be used as a basis for training. Training shall be a formal session, held after the equipment and/or system is completely installed and operational in its normal operating environment.

#### K.6 EXTRA MATERIALS

As part of the Work, Contractor shall provide spare parts, extra maintenance materials, and other materials or products in the quantities specified in the specifications, prior to final payment. Delivery point for extra materials shall be designated by the Owner's Authorized Representative.

#### ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON K.7 ENVIRONMENTAL CLEAN-UP

As part of the Final Completion notice, or as a separate written notice submitted with or before the notice of Final Completion, the Contractor shall notify the Owner that all environmental pollution clean-up which was performed as a part of this Contract has been disposed of in accordance with all applicable rules, regulations, laws, and statutes of all agencies having jurisdiction over such environmental pollution. The notice shall reaffirm the indemnification given under Section F.5.1 above.

#### K.8 CERTIFICATE OF OCCUPANCY

The Contractor shall not be granted Final Completion or receive final payment if the Owner has not received an unconditioned certificate of occupancy from the appropriate state and/or local building officials, unless failure to obtain an unconditional certificate of occupancy is due to the fault or neglect of Owner.

#### K.9 OTHER CONTRACTOR RESPONSIBILITIES

The Contractor shall be responsible for returning to the Owner all items issued during construction such as keys, security passes, site admittance badges, and all other pertinent items. The Contractor shall be responsible for notifying the appropriate utility companies to transfer utility charges from the Contractor to the Owner. The utility transfer date shall not be before Substantial Completion and may not be until Final Completion, if the Owner does not take beneficial use of the facility and the Contractor's forces continue with the Work.

K.10 SURVIVAL

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All warranty and indemnification provisions of this Contract, and all of Contractor's other obligations under this Contract that are not fully performed by the time of Final Completion or termination, shall survive Final Completion or any termination of the Contract

#### SECTION L LEGAL RELATIONS & RESPONSIBILITIES

#### L.1 LAWS TO BE OBSERVED

In compliance with ORS 279C.525, Sections L.2 through L.4 contain lists of federal, state and local agencies of which the Owner has knowledge that have enacted ordinances or regulations relating to environmental pollution and the preservation of natural resources that may affect the performance of the Contract:

#### L.2 FEDERAL AGENCIES

Agriculture, Department of Forest Service

Soil Conservation Service

Coast Guard

Defense, Department of

Army Corps of Engineers

Energy, Department of

Federal Energy Regulatory Commission

**Environmental Protection Agency** 

Health and Human Services, Department of

Housing and Urban Development, Department of

Solar Energy and Energy Conservation Bank

Interior, Department of

Bureau of Land Management

Bureau of Indian Affairs

Bureau of Mines

Bureau of Reclamation

#### ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON Geological Survey

Minerals Management Service U.S. Fish and Wildlife Service Labor, Department of Mine Safety and Health Administration Occupation Safety and Health Administration Transportation, Department of Federal Highway Administration Water Resources Council

#### L.3 STATE AGENCIES

Administrative Services, Department of Agriculture, Department of

Soil and Water Conservation Commission

Columbia River Gorge Commission

Energy, Department of

Environmental Quality, Department of

Fish and Wildlife, Department of

Forestry, Department of

Geology and Mineral Industries, Department of

Human Resources, Department of

Consumer and Business Services, Department of

Land Conservation and Development Commission

Parks and Recreation, Department of

State Lands, Division of

Water Resources Department of

L.4 LOCAL AGENCIES

City Councils

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**County Courts** 

County Commissioner, Board of

Design Commissions

Historical Preservation Commission

**Planning Commissions** 

SECTION 011000 - SUMMARY

PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Work covered by the Contract Documents.
  - 2. Type of the Contract.
  - 3. Work phases.
  - 4. Use of premises.
  - 5. Owner's occupancy requirements.
  - 6. Work restrictions.
  - 7. Specification formats and conventions.
- B. Related Sections include the following:
  - 1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

#### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification:
  - 1. Elmira High School
    - a. Project Location: 24936 Fir Grove Lane, Elmira, OR 97437.
- B. Owner: Fern Ridge School District
  - 1. Owner's Representative: Sally Storm, Superintendent.
- C. Architect: DLR Group Architecture & Planning inc. (an Oregon corporation), 421 SW Sixth Avenue, Suite 1212, Portland OR 97204, telephone: (503) 274-2675.
  - 1. Architect's Representative: Robert Esau.
- D. Construction Manager: Cornerstone Management Group, 31425 SW Country View Ln, Wilsonville, OR 97070.
  - 1. Construction Manger's Representative: Emil Hameed, telephone: (503) 539-2245.

#### 1.4 TYPE OF CONTRACT

A. Combined site and building demolition and construction package.

#### 1.5 WORK SUMMARY

- A. The Work is summarized as follows:
  - 1. Demolition of a portion of the existing entrance canopy, covered walkway at courtyard, and some associated site work and addition of new auxiliary gym, lobby space with concessions and toilets, and renovations to existing girls' locker rooms, storage, and toilets. The work includes an alternate, which addresses an expanded lobby.

#### 1.6 OWNER-FURNISHED AND CONTRACTOR INSTALLED PRODUCTS

- A. Owner will furnish products indicated. The Work includes providing support systems to receive Owner's equipment, installing such equipment and making plumbing, mechanical, and electrical connections.
  - 1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
  - 2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
  - 3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
  - 4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
  - 5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
  - 6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
  - 7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
  - 8. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
  - 9. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
  - 10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
  - 11. Contractor shall install and otherwise incorporate Owner-furnished items into the Work.

#### 1.7 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

- 1. Limits: Confine constructions operations to areas mutually agreed to by Contractor and Owner.
- 2. Owner Occupancy: Allow for Owner occupancy of Project site.
- 3. Driveways and Entrances: Keep driveways parking garage, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
  - a. Schedule deliveries to minimize use of driveways and entrances.
  - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

#### 1.8 OWNER'S OCCUPANCY REQUIREMENTS

- A. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
  - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
  - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
  - 3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
  - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

#### 1.9 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be performed during times mutually agreed to by Contractor and Owner.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Owner's written permission.

#### 1.10 WATERTIGHT – WEATHERTIGHT

A. Content of the Contract Documents notwithstanding, the Contractor accepts the responsibility of constructing a watertight, weathertight project.

- B. Discovery of Fungi (Mold): In accordance with Subparagraph A of this article above, Contractor is responsible for providing labor, material, products, equipment and services to install insulation, air/vapor barrier, and ventilation systems that maintain effective control of air, moisture, and heat transfer within the building envelope.
  - 1. Should Contractor proceed to install insulation, ceiling tiles, gypsum wallboard or similar products having paper, cardboard and other cellulose surfaces prior to the building's being enclosed and weatherproof (including ambient conditions of temperature and humidity being continuously maintained at values near those indicated for final occupancy), the Contractor is at risk for mold contamination of the building components.
  - 2. During the course of construction of the Project, Contractor shall perform continuous visual inspection/verification of building components and ventilation systems (particularly for damp filters) for possible contamination by mold.
  - 3. If the presence of mold is suspected, detected or found, visible water damage observed or musty odors detected, immediate remediation action shall be initiated by the Contractor. In all instances, any source(s) of water shall be stopped and the extent of water damage determined. Water-damaged materials shall be immediately removed and replaced with new materials at the Contractor's expense. The Contractor shall provide an approved independent test report documenting the completed environmental status.
    - a. Mold-damaged materials shall be remedied in accordance with Contractor's Mold Remediation Plan.
    - b. Contractor shall submit his Mold Remediation Plan, which outlines and describes in detail the procedures and policies to be followed for this Project.

#### 1.11 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "Master Format" numbering system.
  - 1. Section Identification: The Specifications use Section numbers and titles to help crossreferencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
  - 2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
  - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for

clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

#### 1.12 MISCELLANEOUS PROVISIONS

- A. Approved Applicators: Where specific instruction in the specifications or drawings require that particular products, equipment or material be installed or applied by an approved applicator of the manufacturer, it shall be the Contractor's responsibility to ensure that any entity or workers used for such Work be an approved applicator, and shall be so documented in writing.
- B. Work includes, but is not limited to:
  - 1. Maintaining pedestrian and vehicular access to and around existing facilities.
  - 2. Not encumbering site access with materials or equipment.
  - 3. Obtaining and paying for use of additional storage or work areas needed for operations.
  - 4. Controlling all movement of water on project site to prevent erosion of soils, oversaturation of soils, downstream erosion and runoff, etc.
- C. The Fern Ridge School District assumes that walls, doors, etc., identified for demolition or alteration contain lead paint. The Contractor shall comply with all OSHA requirements. Per OAR 437 Division 2, General Occupancy Safety and Health Rules (29CFR1910 Subdivision Z, Toxic and Hazardous Substances).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

#### SECTION 011001 – GEO-TECHNICAL INVESTIGATION AND REPORT

PART 1 - GENERAL

- 1.1 SUMMARY
  - A. GEO-TECHNICAL SITE INVESTIGATION AND RECOMMENDATIONS FOR ELMIRA HIGH SCHOOL
    - 1. A copy of the Report of Geotechnical Site Investigation and Recommendations, Elmira High School, 24936 Fir Grove Lane, Elmira, Oregon prepared by K & A Engineering, Inc., dated August 28, 2014 has been included at the end of this section and is considered a part of the Contract Documents. Requirements identified in the report are considered as binding as those specifically conveyed in the remainder of the Project Manual and the Drawings. In the event of a conflict, the Contractor is to immediately bring it to the attention of the Architect, in writing.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011001

## GEOTECHNICAL SITE INVESTIGATION AND RECOMMENDATIONS

011001a ATTACHMENT TO SECTION 011001

## **ELMIRA HIGH SCHOOL**

24936 Fir Grove Lane Elmira, Oregon

August 28, 2014

by

Michael Remboldt, P.E., G.E.



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## August 28, 2014

Fern Ridge School District c/o Scott Rose, DLR Group 421 SW Sixth Avenue, Suite 1212 Portland, OR 97204-1613

Subject: Geotechnical Foundation Investigation and Report

Elmira High School - 24936 Fir Grove Lane, Elmira, Oregon

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## **EXECUTIVE SUMMARY**

Based on our extensive investigation of the site it is our opinion that the site is suitable for the proposed modifications, additions, and new construction. There are no significant geologic hazards at the site and we anticipate that the needs for foundation support will be satisfied by conventional shallow spread footing systems.

Site soils are characterized as consisting of 2 to 4-feet of highly variable soils (organics, loose fills, construction debris) over native gravelly silty and clayey soils. Groundwater was not consistently found at depths up to 23-feet.

The primary constraint for design and construction of improvements is the variable nature of the top 2 to 4-feet of soils at the site. We expect that foundation pads will have to be excavated to a depth ranging from 3 to 4-feet to suitable native subgrade soils, and then filled partially with a good quality select granular fill to the desired footing grade. Ensuring the foundations are supported on quality subgrade soils will require vigilance and we highly recommend that K & A Engineering, Inc. be involved during construction to work together with the owner, designer, and contractor to assist with the identification of poor soils and to address hidden or latent conditions that are often found during construction of this type in a previously-developed site.

The underlying native gravelly silts and clays offer reasonably good support but are prone to larger elastic settlement with large loads and wider spread footings. Our recommendations in this report limit footing size and allowable bearing capacity to keep expected elastic settlement within reasonable bounds. Please note that it may be in the best interest of the project to consider using a micropile foundation system for very large loads from, for instance, a tall concrete tilt-up wall system supporting long-span roofs. This would limit settlement and improve reliability and a cost that is only slightly more than constructing large, wide conventional spread footings.

## PURPOSE AND SCOPE

As requested we have completed a geotechnical foundation investigation of the site of proposed additions and new buildings for the existing Elmira High School located at the subject project site address. The purpose of our investigation was to characterize subsurface soil conditions and develop recommendations for geologic hazards, site development, and foundation support.

Our understanding is that building additions may include conventional framing, concrete tilt-up, and masonry construction.

The scope of our services included making borings and probes at the project site, engineering analysis of field data, and this written report.

## **INVESTIGATION AND FINDINGS**

#### **Site Surface Conditions**

The project site consists of developed areas around the existing high school. The high school is centered in an approximately 22.5-acre parcel located north of Oregon Highway 126 and east of Territorial Road, north of Elmira. See the attached Vicinity Map.

The High School site is situated on the west edge of the southern Willamette Valley in a rural area between Fern Ridge Reservoir, located approximately 1-mile to the east, and the foothills of the coast mountain range. The ground surface of the general area is relatively flat, with vegetation including a mix of grass and trees. We observed no indications on the project site, or on the areas surrounding the site, of slope movement or unstable soils.

## Local Geology

Mapped surface geology of the area including the project site consists of early Quaternary and late Tertiary weathered terrace gravels.<sup>1</sup> These deposits consist of unconsolidated to semi-consolidated terrace deposits of

<sup>&</sup>lt;sup>1</sup> McClaughry, Wiley, Ferns, Madin, Digital Geologic Map of the Southern Willamette Valley, Benton, Lane, Linn, Marion, and Polk Counties, Oregon; Oregon Department of Geology and Mineral Industries; Open File Report 0-10-03, 2010.

clay, silt, sand, and volcaniclastic gravels. The gravels are typically very weathered and generally not suitable for aggregate.

Our observations of subsurface soil conditions in our borings and probes confirm this mapping.

## **Subsurface Conditions**

### Subsurface Investigation Method

We investigated subsurface soils by making probes and borings.

Friction cone (FC) probes consist of driving a "friction cone" into the soil using an automatic hammer. The friction cone is a steel cone having a projected tip area of approximately  $20 \text{-cm}^2$  and a 5-cm diameter x 5.5-0-cm long sleeve. The cone is driven into the soil using a 63.5-kg (140-lb) automatic trip hammer falling 76-cm (30-in). Tip pressure during driving is calculated based on the penetration rate and mass of the hammer assembly and drill string. Soil friction on the sleeve is determined by turning the cone using a calibrated torque wrench at intervals during driving. Tip pressure during driving is an excellent indicator of soil modulus and strength, and the ratio of slide friction to tip pressure is an accurate indicator of soil grain size.

Borings consist of continuous undisturbed sampling made using a duplex steel sampler and casing system. Samples are taken in 1-m lengths and preserved for laboratory evaluation in sealed plastic liners.

Groundwater conditions in the probes and boring can be estimated by observation of water on the drill rods, in the cases of the friction cone probes, and by direct observations in the borings.

#### Subsurface Soils

We made six (6) friction cone probes and two (2) continuous-sample borings using our track-mounted geotechnical drill.

The approximate locations of the borings (B-1 and B-2) and friction cone probes (FC-1, FC-2, FC-3, FC-4, FC-5, and FC-6) are shown on the attached Boring Location sketch.

Generally, with the exception of the top 2 to 4-feet, subsurface soil conditions were found to be very similar across the area investigated. Soils consist of:

- Variable surface treatments including:
  - 1.0 to 1.5 feet of organic SILT with roots in grassy or planter areas (FC-1/B-1, FC-2/B-2, FC-5, and FC-6) or 1.5 to 2-inches of HMA pavement over 6 to 8-inches of <sup>3</sup>/<sub>4</sub>" 0 crushed aggregate base, over
  - 1 to 3-feet of brown, dry to damp, loose to moderately dense, SANDS, SILTY-SANDS, AND SANDY-SILTS.
- 12 TO 16-feet of mottled tan/yellow/brown/red, moist, moderately stiff to very stiff CLAYS, SILTY-CLAYS, AND CLAYEY-SILTS, over
- Mottled tan/yellow/brown/red, moist to wet, GRAVELLY SILTY-SANDS/SANDY-SILTS, and GRAVELLY CLAYEY-SILTS/SILTY-CLAYS. The gravels consist of rounded, highly weathered, tuffaceous siltstone and basalt.

Note that the study area is an existing developed site, and the top 2 to 4-feet is highly variable. As indicated above, this zone could include organic silts, roots, aggregates, asphalt surfacing, and possibly fills constructed of imported soils. Under surface organics (lawn and planter areas) and paved areas, we found a 1 to 2-foot

zone of loose to moderately dense, dry, friable silt and sandy-silts. Some of these sandy-silts had remnants of roots suggesting that these soils could have been constructed fills.

The maximum depth of our exploration was 7-m (23-feet). The probes were terminated in the dense gravely deposits where the density appeared to increase significantly with depth.

We did not find consistent indicators of groundwater at the site. While probe rods indicated wet soil conditions at FC-1, groundwater was not observed in the open boring of B-1 (close to FC-1) after 24-hours. Similar wet soils were observed at the nearby Elmira Elementary School. Our understanding is that a water line between the High School and the Elementary School, which runs near B-1/FC-1, is known to have significant leakage. This could explain the observation of wet soils without groundwater developing in the boring.

A search of groundwater monitoring well data for Lane County in the area revealed one well, located in southwest Veneta that appears to be in the same geologic unit as the project site.<sup>2</sup> Water levels ranged from 50 to 70-feet in depth at the Veneta well, and 15 to 30-feet in depth in the Fern Ridge well.

## SUMMARY AND RECOMMENDATIONS

#### General Suitability of the Site for the Proposal

In general we recommend that the site is suitable to support the proposed foundation system if our recommendations in this report are followed.

The primary constraints at this site due to subsurface soil conditions, from a site development standpoint, are:

- The highly variable nature of the top 2 to 4-feet of surface materials (organic soils, pavements, possible fills, and construction materials) and
- Underlying silty-clayey soils that could present a low to moderate hazard of differential and total settlement. These soils are lightly to moderately over-consolidated and foundation settlement is expected to be due to elastic compression of the low-plasticity silts and clays.
- Soil Heaving. The silty and clayey soils underneath the top 2 to 4-foot surface zone have a low to moderate potential for volume changes with changes in water content.

## Geologic Hazards

## Design Earthquake

The design earthquake was determined an event having a 10-percent chance, or higher, of occurring within a 50-year period. Based on analysis using current modeling of local sources of earthquake ground motion (crustal, deep, and subduction zone)<sup>3</sup>, the design earthquake is a magnitude 9 event, with a peak ground acceleration is 0.15g.

#### Faulting and Lateral Spreading

Ground rupture from faulting is not a hazard at this site. There is one small mapped northeast-southwest trending normal fault mapped approximately 8 to 10-miles northwest of the project site. This fault is parallel with another fault located approximately 15-miles southeast of the site and neither fault intersects the site. There is not a hazard of surface rupture of lateral spreading from movement on this fault.

<sup>2</sup> Oregon Water Resources Department Well Lane 8733. See

http://filepickup.wrd.state.or.us/files/Publications/obswells/wells/well LANE008733.html

<sup>3</sup> 2008 NSHMP PSHA interactive deaggregation analysis, on-line at the USGS Geologic Hazards Science Center. http://geohazards.usgs.gov/deaggint/2008/

### Expansive Soils

The underlying elastic (low plasticity) silts and clays are estimated to have a relatively low liquid limit and have a low to moderate potential for volume change with changes in water content. If our recommendations for site preparation are followed, this hazard will be mitigated for foundations.

### Differential Settlement

There is a low to moderate hazard for differential settlement of shallow spread footings. Our recommendations for foundations are made to mitigate this hazard.

## Earthquake Ground Motion – Structural Design Criteria

For designing lateral bracing systems and other structural elements for earthquake ground motion, we recommend that design criteria be selected based on a site class "D – Stiff soil profile."<sup>4</sup> The recommended design spectral response acceleration parameters are shown on Table 1.

Design Parameter	Design Value
S <sub>Ms</sub> (site class "D")	1.043
S <sub>M1</sub> (site class "D")	0.726
S <sub>Ds</sub> (site class "D")	0.696
S <sub>D1</sub> (site class "D")	0.484

Table 1 – Recommended Seismic I	Design	Parameters
---------------------------------	--------	------------

For design of "non-structural" elements and anchorages for lateral earthquake loads, we recommend a design peak ground acceleration of 15%g (10% chance of exceedance in 50-years).

See the attached USGS Summary Report.

## Site Development

#### Stability of Existing Foundations

We assume that the nature of much of the proposed project will include preparing improved areas around existing buildings for new foundations that will support additions to existing structures.

Due to the proximity of this work adjacent to existing foundations, extreme caution will be required when excavating near and/or exposing existing foundations. Depending on the depth of excavation required to find suitable subgrade soils for new foundations, underpinning of existing foundations may be necessary to avoid undermining existing footings which could cause extreme settlement or collapse of the existing foundation/structure.

K & A Engineering, Inc. should be on site during excavation and preparation of foundation pads to provide and assessment of existing footings and additional recommendations for stabilization, if necessary.

<sup>&</sup>lt;sup>4</sup> 2010 Oregon Structural Specialty Code.

## Clearing and Foundation Pad Preparation

All of the areas in proposed areas for work have surface deposits of soils and other materials that must be removed and/or replaced. These materials include surface organics (sod, organic soils, and root-laden soils), fills (loose sandy-silts or silty-sands that appeared, in some cases, to be undocumented fills), and quite possibly other unsuitable materials including construction debris from previous construction activity. These materials shall be removed from areas to receive new foundations and slabs-on-grade. We expect the depth of removal to range from 2 to 4-feet across the site. K & A Engineering, Inc. shall identify unsuitable soils to be removed during foundation pad excavation.

The subgrade supporting new footings shall be on underlying non-organic dense/stiff soils a minimum depth of 2.5-feet below the proposed final grade on each side of the footings. The subgrade shall be level, or excavated in level benches to accommodate slope areas. The excavation for new footings shall extend laterally, from all sides of the footing, a minimum distance equivalent to the depth of approved subgrade below the base of the footing.

Prior to construction of footings or placement of structural fills, the approved subgrade shall be smoothed and compacted. We recommend the use of a flat backhoe bucket to avoid tearing and disturbance of soils at the base of the excavation. If compaction is necessary, soils shall be compacted to a dry density equal to or greater than 95% of maximum as determined by ASTM D698 OR shall be compacted to the satisfaction of K & A Engineering, Inc. by visual observation. For large areas the subgrade may be tested for suitability by "proof-roll" testing using a loaded 40-kip, tandem-axle loaded dump truck. K & A Engineering, Inc. shall be present for any proof-roll testing.

Structural fill, placed on the approved subgrade to the desired footing grade(s), shall consist of Select Granular Fill meeting the requirement in the Specifications of this report, placed on the approved foundation pad subgrade, and compacted according to the requirements in the Specifications. The select granular fill shall be graded to the footing grade(s) specified by the project Architect.

K & A Engineering, Inc. should be at the site during foundation pad preparation to verify the depth of removal of unsuitable soils including organics, fill, and other unsuitable materials, to approve subgrade soils prior to placement of structural fill, and to approve fill materials and placement. K & A Engineering, Inc. has no liability for foundation damage or settlement due to improper site preparation, subgrade preparation, or structural fills made without our observation and approval.

#### **Buried Utilities**

All utilities under areas that will support new foundations must be accurately located and removed and/or relocated. <u>We specifically require that new foundations shall NOT be constructed over buried existing utilities.</u>

All utility lines (pipes, wires, etc.) AND the utility trench backfill shall be removed in areas of new foundations and filled with Fine Select Granular Fill, compacted as specified in the Specifications below.

## Cuts and Fills

Temporary cuts shall have a slope not exceeding 1 horizontal : 1 vertical. All temporary cut slopes shall be protected from excessive erosion. Permanent cut embankments shall not exceed a slope of 2 horizontal : 1 vertical and shall be permanently protected from surface erosion by placement of stone armoring or a permanent vegetative cover.

Permanent fill embankments shall be placed on non-organic, undisturbed native soils that have been benched to receive the fill. Permanent fill slopes shall not exceed a slope of 3 horizontal : 1 vertical and shall be placed in layers not exceeding 12-inches and compacted to a minimum dry density of 95% of maximum as determined by ASTM D698. Permanent fill embankments may be constructed using Native Structural Fill or Select Structural Fill.

## Wet Weather Construction

The underlying silty and clayey soils that will form the approved subgrades for foundations are below the plastic limit and sensitive to increasing water content from exposure to wet weather. This means that these soils could experience rapid loss of strength if exposed for long periods of time to rain. Care should be taken to avoid excavation or exposure of these soils during periods of extended rainfall.

Open excavations shall be covered during periods of extended wet weather to avoid softening of the subgrade. Soils softened by rain or standing water shall be removed and replaced with Select Granular Fill.

## Utility Trenches

There is not an unusual hazard of collapse of utility trenches in the soils found at the site. However, trenches deeper than 4-feet should be shored to provide safety during placement of utilities.

#### **Foundation Support**

#### Foundations

Based on our understanding of possible options for new structures, there may be variety of foundation line loads, depending on the type of buildings to be constructed. Foundation line loads could vary from 1 to over 3-kips per lineal foot.

If our recommendations are followed for limiting allowable bearing capacity, we recommend that conventional cast-in-placed reinforced concrete isolated and strip spread footings are suitable to support foundation loads.

Footings shall be constructed on the approved compacted Select Granular Fill placed on the approved Subgrade.

#### Allowable Bearing Capacity and Settlement

For spread footings supported on the foundation pad constructed according to our recommendations, the design allowable foundation bearing capacity is 2,000-pounds per square foot. Footings shall be supported either directly on approved native subgrade soils or on Select Structural Fill that extends to approved native subgrade soils that are a minimum depth of 2.5-feet below the final grade around the new foundation system.

The maximum amount of *total* settlement is expected to be 1-inch or less, and the expected amount of *differential* settlement is expected to be  $\frac{1}{2}$  - inch or less.

To limit settlement, strip footings shall not exceed a width of 2.5-feet, and isolated footings shall not exceed a width of 4-feet. Large loads that cannot be accommodated by these constraints shall be supported by deep foundation elements such as micropiles or drilled piers. K & A Engineering, Inc. should be contacted to provide additional design criteria in these cases.

## Slabs-on-Grade

Slabs-on-grade should be supported by Select Granular Fill that extends to non-organic native, undisturbed silts, silty-sands, sandy-silts, or clayey soils a minimum of 18-inches below the base of the slab-on-grade.

To maximize slab-on-grade performance we also recommend:

- Slab thickness of 5-inches (minimum),
- Fiber-reinforced concrete,
- Slab reinforcement consisting of #4 (grade 40) reinforcement bars spaced at 24-inches o.c. each way and centered in the slab, and
- Saw-cut control joints spaced a maximum of 10-feet in each direction. Saw-cutting of the slab-ongrade shall be made as soon as the slab has enough hardness to support saw cutting machinery. We recommend saw cuts 1/4-inch wide x 1/2-inch deep.

## **Pavements**

We anticipate that new pavements will support mostly light passenger car traffic, school buses, delivery vehicles, garbage and other service trucks, and the occasional construction vehicle or large truck. We have determined the minimum pavement structure based on the traffic summarized on Table 1.

		Days/	Weeks/	Analysis	Gross Weight	
Vehicle	Qty.	Week	Year	Period, yr.	(lb.)	18-k ESAL's
Passenger car	200	5	40	20	4,000	320
Pickup	50	5	40	20	6,000	440
School Bus	20	5	40	20	22,000	31,000
Package Delivery Truck	3	5	52	20	18,000	5,550
Other Delivery Truck	2	1	40	20	30,000	620
Garbage Truck	4	2	52	20	55,000	23,210
Dump Truck (full)	1	1	5	20	68,000	260
Semi-tractor trailer (full)	1	1	5	20	80,000	230
HS-20 Truck	1	1	5	20	40,000	1,240
Total AASHTO 18-k ESAL					62,870	

Table 2 - Design Traffic Summary for Pavement Design

Pavements shall consist of:

- 2-inches (minimum) of Hot Mix Asphalt (HMA), over
- 10-inches of Aggregate Base, over
- Pavement Geotextile that is placed on
- Undisturbed or compacted soil subgrade approved by K & A Engineering, Inc.

We calculated this minimum structure to provide the design traffic with a reliability of 80% over a 20-year life. A copy of our design calculations is attached to this report.

Pavement soil subgrades supporting pavements shall consist of non-organic silts, sandy-silts, silty-sands, or clayey-silts. After grading the subgrade, and prior to placement of pavement geotextile, the subgrade shall be tested for uniformity in support using a loaded 40-kip tandem axle dump truck in a series of "proof-roll" tests. Areas of subgrade that experience significant deformation, rutting, or "pumping" under the proof-roll wheel load, shall be identified by K & A Engineering, Inc. and removed and replaced with Select Granular Fill that is placed and compacted according to the Specifications below.

## **Retaining Walls**

## General Requirements

Due to the relatively flat nature of the site and existing differences in elevation between the school grounds and the parking areas, we anticipate that retaining walls may be required to provide up to 6-feet of separation.

We do not anticipate retaining walls to support traffic loads. Our recommendations for design criteria for cantilevered cast-on-place concrete retaining walls assume that the walls will NOT support adjacent footings or induced increased lateral pressures from adjacent footings. If retaining walls will support fills which support footings closer than 6-feet to the back face of the retaining wall, K & A Engineering, Inc. should be contacted to provide additional design recommendations. If wall systems other than cast-in-place concrete cantilevered walls are desired, we would be happy to provide additional design criteria.

## Design Criteria – Cantilevered Concrete Retaining Walls

For cast-in-place concrete cantilevered retaining walls, we recommend a design lateral earth pressure (equivalent to a fluid pressure) of 44-psf/ft. The recommended maximum design passive pressure for resistance to sliding at the footing shall be 270-psf/ft. The design coefficient of sliding for a footing on native silts/clays shall not exceed 0.4.

## Retaining Wall Foundations

Retaining wall footings shall be supported on subgrades and Select Granular Fills that are prepared and placed in the same manner as recommended for Foundations.

## Retaining Wall Backfill

Retaining wall backfill shall consist of either Native Structural Fill or Select Granular Fill. Backfill shall be placed in 12-inch maximum layers (loose) and moderately compacted using small hand-operated compaction equipment such as a vibratory plate compactor or whacker-compacter. Care should be taken to avoid excessive compaction directly behind the wall.

## Retaining Wall Drainage

Retaining wall drainage shall be provided by either installing weep holes that drain the backfill to daylight at the toe of the wall or by a conventional buried footing drain.

Weep holes should consist of 2-inch minimum diameter PVC sleeved holes spaced at 10-feet maximum o.c. Drain Rock, enveloped with Separation Geotextile, shall be placed on the inlet side of the weep holes on the footing heel, and shall be placed to a height so that the inlet side of the weep holes are covered by drain rock and the separation geotextile.

Conventional footing drains shall consist of a 3-inch minimum diameter perforated drainpipe covered by a minimum of 12-inches of Drain Rock that is enveloped with Separation Geotextile. The perforated pipe shall be connected to a collector that routes intercepted water to an appropriate disposal point.

## SPECIFICATIONS

## Materials

## Select Granular Fill

Select granular fill may consist entirely of fine select granular fill or a minimum of 9-inches of coarse select granular fill covered with a minimum of 3-inches of fine select granular fill.

## Fine Select Granular Fill

Fine select granular fill should consist of clean, durable, well-graded material with a maximum particle size of 3inches and a maximum of 10-percent passing the no. 200 sieve. Select granular fill shall be placed in layers not to exceed 12-inches (loose) and mechanically compacted to a dry density exceeding 95-percent of maximum as determined by ASTM D698 (Std. Proctor).

## Coarse Select Granular Fill

Coarse select granular fill shall consist of clean, well-graded quarry stone having a maximum particle size of 5-inches. Quarry stone should be durable and have 100-percent fractured faces.

Alternatively, with the review and approval of K & A Engineering, Inc., coarse select granular fill may consist of well-graded "bar-run" gravels from a local alluvial source. <u>All "bar-run" MUST be evaluated and approved by K & A Engineering, Inc. prior to placement</u>. "Bar-run" coarse select granular fill shall pass the 4-inch sieve and shall have no more than 10-percent, by weight, passing the no. 200 sieve.

Coarse select granular fill shall be placed in 12-inch layers and compacted using a heavy vibratory steel drum roller. <u>Adequate compaction should be determined in the field by a K & A Engineering, Inc. representative.</u>

## Aggregate Base

Aggregate, intended to support pavements, base should consist of clean, durable, well-graded material with a maximum particle size of 1 1/2-inches and a maximum of 10-percent passing the no. 200 sieve. Aggregate base shall be placed in layers not to exceed 12-inches (loose) and mechanically compacted to a dry density exceeding 95-percent of maximum as determined by ASTM D1557 (modified proctor).

## Drain Rock

Drain rock should consist of 3/4-inch clean, open-graded, and durable angular quarry stone. Drain rock shall not have more than 5% passing the #4 sieve (US std. sieve).

## Native Structural Fill

Native structural fill may consist of re-compacted brown silty-sands, sands, or sandy-silts removed from underneath surface organics or pavements. These soils shall be placed in layers not exceeding 12-inches and compacted using vibratory steel drum roller, vibratory plate, or whacker compactor to a minimum dry density of 95% of maximum as determined by ASTM D698.

Native structural fills shall NOT be used to support permanent foundations.

## Subgrade

Subgrade refers to undisturbed or compacted native sandy-silt, silty-sand, clayey-silt, and silty-clays under stripped organic soils, pavements, and existing fills. K & A Engineering, Inc. shall identify and verify suitable subgrade prior to fill placement and footing construction.

## Separation Geotextile

Separation geotextile should consist of a non-woven, needle-punched, polypropylene fabric meeting the following specifications:

Property	Test	Specification
	Method	-
Grab Strongth	ASTM	> 1 4 KN
Grab Strength	D4632	> 1.4 KN
Toor Strongth	ASTM	> 0.5 kN
	D4533	> 0.3 KN
Duncture Strength	ASTM	> 0.5 kN
Functure Strength	D4833	> 0.3 KN
Burst Strongth	ASTM	> 3 500 kPa
Buist Strength	D3786	> 3,300 KF a
Dermittivity	ASTM	> 02 sec <sup>-1</sup>
1 emiliavity	D4491	> .02 3€€
Apparent Opening Size (AOS)	ASTM	< 70 (US Std. Siovo)
Apparent Opening Size (AUS)	D4571	< 70 (03 3 ld. 3 leve)
Illtraviolet Stability	ASTM > 50% ret. After 5	
On avoiet Stability	D4355	exposure

#### Table 3 - Separation Geotextile Specifications

A manufacturer's printed certification is acceptable as proof of compliance in lieu of laboratory testing.

Separation geotextile should be placed free of wrinkles or other discontinuities. Torn, punctured, or damaged fabric should be replaced. Separation geotextile should have a minimum lap at seams of 12-inches.

## Pavement Geotextile

Pavement geotextile should consist of a woven polypropylene fabric meeting the following specifications:

Table 4 -	Pavement	Geotextile	Specifications
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Property	Test Method	Specification
Grab Strength	ASTM D4632	> 1.4 kN
Tear Strength	ASTM D4533	> 0.5 kN
Puncture Strength	ASTM D4833	> 0.5 kN
Burst Strength	ASTM D3786	> 3,500 kPa

Property	Test	Specification
	Method	
Permittivity	ASTM	> 05 apo <sup>-1</sup>
	D4491	> .00 Sec
Apparent Opening Size (AOS)	ASTM	< 70 (IIS Std. Sigure)
	D4571	< 70 (03 Slu. Sleve)
Ultraviolet Stability	ASTM	> 50% ret. After 500 hours
	D4355	exposure

A manufacturer's printed certification is acceptable as proof of compliance in lieu of laboratory testing.

Pavement geotextile should be placed free of wrinkles or other discontinuities. Torn, punctured, or damaged fabric should be replaced. Separation geotextile should have a minimum lap at seams of 12-inches.

## Drain Pipe

Drainpipe for foundation drain systems shall consist of rigid schedule 40 PVC. Perforations should be either prefabricated by the pipe supplier, or constructed by drilling ½-inch diameter holes spaced at 8" into solid pipe. Perforations should be placed down. K & A Engineering, Inc. should be contacted to review and approve perforated drainpipe prior to installation.

## **Materials Placement Specification**

General recommendations for placement of earthwork and specified materials are as follows:

- Excavate and remove all unsuitable soils in areas to receive foundations, slabs-on-grade, and pavements. K & A Engineering, Inc. shall verify and approve suitable subgrade soils prior to placement of fills.
- Grade approved subgrade soils level or in level benches (for sloped areas). Remove all loose debris.
- Compact disturbed areas of subgrade soils to provide an in-place density that is equal to or greater than the native undisturbed soils, as verified in the field by K & A Engineering, Inc.
- Place specified select granular fills for footings, slabs-on-grade, and pavement areas on the prepared subgrade to the desired grades. Place the select granular fill in lifts and compact each lift to the in-place density specified for the material used.
- All Fine select granular fills and Aggregate Base rock (under pavements) shall be tested randomly for in-place density. Testing shall be provided by an independent testing laboratory.
- After footing construction, place non-structural fills around foundations to slope away from structures.

## LIMITATIONS AND USE OF GEOTECHNICAL RECOMMENDATIONS

This report has been prepared for the exclusive use of the Fern Ridge School District for the subject project.

This geotechnical investigation, analysis, and recommendations meet the standards of care of competent geotechnical engineers providing similar services at the time these services were provided. We do not warrant or guarantee site surface subsurface conditions. Exploration test holes indicate soil conditions only at specific locations (i.e. the test hole locations) to the depths penetrated. They do not necessarily reflect soil/rock materials or groundwater conditions that exist between or beyond exploration locations or limits.

The scope of our services does not include construction safety precautions, techniques, sequences, or procedures, except as specifically recommended in this report. Our services should not be interpreted as an environmental assessment of site conditions.

Thank you for the opportunity to be of service. Please call us if you have questions or need further assistance.

Sincerely,

Michael Remboldt, P.E., G.E. K & A Engineering, Inc.


# **APPENDIX A**

# MAPS, LOGS, SUPPORTING CALCULATIONS

**GEOTECHNICAL SITE INVESTIGATION AND REPORT** 

Elmira High School

24936 Fir Grove Lane

Elmira, Oregon

Fern Ridge School District

August 28, 2014



8/28/14 Project: 14046

engineering

Drawing 1 / 1

12/31/2014 EXPIRES \_





# BORING LOCATIONS

# LEGEND

1 1



APPROXIMATE BORING LOCATION AND DESIGNATION FC = FRICTION CONEB = CONTINUOUS SAMPLE BORING



K & A Engineering, Inc 91051 S. Willamette St. **Coburg, OR 97408** 541 684 9399 541 684 9358 fax



**BORING LOCATIONS** 

Geotecchnical Site Investigation Elmira High School 24936 Fir Grove Lane, Elmira, Oregon 8/28/14 Project: 14046 Drawing 1 / 1

12/31/2014 EXPIRES \_

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#### DYNAMIC PROBE LOG







PROJECT NUMBER: 14046 08-20-2014 08-20-2014 DATE STARTED: DATE COMPLETED:

SURFACE ELEVATION: WATER ON COMPLETION: HAMMER WEIGHT: CONE AREA:

none observed 63.5 kg

19.6 sq. cm.

DEPTH	BLOWS PER 20 cm	SLEEVE Torque	ADHESION	q <sub>c</sub> - Net Cone Tip resistance	Tip Pressure q <sub>c</sub> , kg/cm <sup>2</sup> Friction Ratio, %	CALCULATED SPT N <sub>60</sub>	
		ftIbs.	Kg/cm²	Kg/cm²	1 10 100 1000 0% 5% 10% 15%	6 N <sub>60</sub>	INFERRED SOIL DESCRIPTION
-	9	2	0.11	41.2		6	Mod. Dense to Dense
-	17	47	2.49	53.3		26	Sands and Silts
-	5	26	1.39	20.4		12	0.117
-	7	35	1.86	24.3		16	Stiff
- I M	8	44	2.32	24.4		19	Clays and Slity-Clays
-	1	30	1.60	23.9		10	
-	0	21	1.02	22.1		14	
_	15	31	1.62	50.6		20	Very Stiff
-2 m	15	31	1.62	49.4		19	Clavey-Silt and Silty-Clavs
-	12	29	1.54	40.8		17	ongoy one and only ongo
-	5	28	1.45	19.9		12	Stiff
-	4	29	1.55	16.3		12	Clays and Silty-Clays
-	4	31	1.64	15.7		13	
-3 m	6	33	1.74	21.1		14	
-	6	31	1.62	21.8		14	
-	5	29	1.51	19.5		13	
-	6	26	1.39	23.1		13	
-	5	24	1.28	20.8		11	
-4 m	4	22	1.16	18.6		10	
-	6	21	1.10	24.7		11	
-	4	20	1.04	19.3		10	
-	10	19	0.99	36.8		13	Moderately Stiff
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# 8/28/2014 **EUSGS** Design Maps Summary Report

**User-Specified Input** 

Report Title	Elmira High School Fri August 29, 2014 05:38:43 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	44.07359°N, 123.36092°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	IV (e.g. essential facilities)



USGS-Provided Output

$S_s =$	0.922 g	$S_{MS} =$	1.043 g	$S_{DS} =$	0.696 g
$S_{1} =$	0.477 g	S <sub>M1</sub> =	0.726 g	$S_{D1} =$	0.484 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.



For PGA<sub>M</sub>,  $T_L$ ,  $C_{RS}$ , and  $C_{R1}$  values, please <u>view the detailed report</u>.



# Fern Ridge Schools Elmira and Veneta, Oregon

# Flexible Pavement Design - School Parking and Driveways<sup>1</sup> Input Variables Pavement Materials: Surface coefficient, Surface Thickness (inches), a<sub>1</sub> := .42 $N_1 := 2$ Base coefficient, $a_2 := .14$ Base Thickness (inches), $N_2 := 10$ Subbase coefficient, $a_3 := .09$ Subbase Thickness (inches), $N_3 := 0$ Structural Number, $SN := a_1 \cdot N_1 + a_2 \cdot N_2 + a_3 \cdot N_3$ SN = 2.24Reliability: Design Reliability Level, % R := 80 Standard Normal Deviate, $Z_r := qnorm \left( \frac{100 - R}{100} \right), 0, 1$ Overall Design Standard Deviation, $S_0 := 0.45$ $Z_r = -0.842$ Performance: Initial Serviceability Index, $p_0 := 4.5$ Terminal Serviceability Index, $p_t := 2.5$ $\Delta PSI := p_0 - p_t$ $\Delta PSI = 2$ Subgrade Soils: Estimated CBR (psi), CBR := 4Subgrade Resilient Modulus (psi), $M_r := 2555 \cdot (CBR)^{0.64}$ $M_r = 6205$ Output $\begin{bmatrix} Z_{r} \cdot S_{0} + 9.36 \cdot \log(SN+1) - .2 + \frac{\log\left(\frac{\Delta PSI}{4.2 - 1.5}\right)}{.4 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \cdot \log(M_{r}) - 8.07 \end{bmatrix}$ $W_{18} := 10^{L}$ $W_{18} = 7.644 \times 10^4$ <sup>1</sup>AASHTO Guide for Design of Pavement Structures, 1993 Client: Fern Ridge School Dist. K & A Engineering, Inc. 8/29/2014 Project: 14046

## SECTION 012500 - SUBSTITUTION PROCEDURES

#### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Section 004020 "Alternates" for products selected under an alternate.
  - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

#### 1.3 DEFINITIONS

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

#### 1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use CSI Form 13.1A.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.

- b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
- c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
- e. Samples, where applicable or requested.
- f. Certificates and qualification data, where applicable or requested.
- g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
- h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
- i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
- j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
- k. Cost information, including a proposal of change, if any, in the Contract Sum.
- 1. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
- m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
  - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

# 1.5 QUALITY ASSURANCE

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

## 1.6 PROCEDURES

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

# PART 2 - PRODUCTS

# 2.1 SUBSTITUTIONS

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

- b. Requested substitution does not require extensive revisions to the Contract Documents.
- c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- d. Substitution request is fully documented and properly submitted.
- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

# SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

#### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
  - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

#### 1.3 MINOR CHANGES IN THE WORK

A. Architect will issue through Construction Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

#### 1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- e. Quotation Form: Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail."
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
  - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  - 4. Include costs of labor and supervision directly attributable to the change.
  - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
  - 7. Proposal Request Form: Use CSI Form 13.6A, "Change Order Request (Proposal)," with attachments CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail."

# 1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

# 1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

# PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
  - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 2. Section 012905 "Wage Rates" for prevailing wage rates.
  - 3. Section 012940 "Certificate of Compliance" for certification by the Contractor that all work has been performed and material supplied in accordance with the contract documents.
  - 4. Section 012980 "Certification of No Asbestos" for certification that no asbestos is used in the construction of the project.
  - 5. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

#### 1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
  - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with continuation sheets.
    - b. Submittal schedule.

- c. Items required to be indicated as separate activities in Contractor's construction schedule.
- 2. Submit the schedule of values to Architect through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
- 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
- 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract as described in Section 011000 "Summary."
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  - 2. Arrange schedule of values consistent with format of AIA Document G703.
  - 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or Division.
    - b. Description of the Work.
    - c. Name of subcontractor.
    - d. Name of manufacturer or fabricator.
    - e. Name of supplier.
    - f. Change Orders (numbers) that affect value.
    - g. Dollar value of the following, as a percentage of the Contract Sum to nearest onehundredth percent, adjusted to total 100 percent.
      - 1) Labor.
      - 2) Materials.
      - 3) Equipment.
  - 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

- a. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
- 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
- 6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
  - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
- 7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
- 8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
- 9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
- 10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
  - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
- 11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

# 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and Construction Manager and paid for by Owner.
  - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the 7th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

- 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- E. Application for Payment Forms: Use forms provided by Owner for Applications for Payment. Sample copies are included in Project Manual.
- F. Application for Payment Forms: Use forms acceptable to Architect and Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.
- G. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- H. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
  - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
  - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  - 3. Provide summary documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- I. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
  - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

- J. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
  - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  - 2. When an application shows completion of an item, submit conditional final or full waivers.
  - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  - 4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- K. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
  - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  - 2. When an application shows completion of an item, submit conditional final or full waivers.
  - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  - 5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.
- L. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
  - 1. List of subcontractors.
  - 2. Schedule of values.
  - 3. Sustainable design submittal for project materials cost data.
  - 4. Contractor's construction schedule (preliminary if not final).
  - 5. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
  - 6. Products list (preliminary if not final).
  - 7. Sustainable design action plans.
  - 8. Schedule of unit prices.
  - 9. Submittal schedule (preliminary if not final).
  - 10. List of Contractor's staff assignments.
  - 11. List of Contractor's principal consultants.
  - 12. Copies of building permits.
  - 13. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  - 14. Initial progress report.
  - 15. Report of preconstruction conference.
  - 16. Certificates of insurance and insurance policies.
  - 17. Performance and payment bonds.
  - 18. Data needed to acquire Owner's insurance.

- M. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
  - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  - 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- N. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
  - 1. Evidence of completion of Project closeout requirements.
  - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  - 3. Updated final statement, accounting for final changes to the Contract Sum.
  - 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
  - 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
  - 6. AIA Document G707, "Consent of Surety to Final Payment."
  - 7. Evidence that claims have been settled.
  - 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  - 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

#### SECTION 012905 – WAGE RATES

#### PART 1 GENERAL

#### 1.1 PREVAILING WAGE (IF APPLICABLE)

- A. The provisions of the State of Oregon ORS 279C.800 to ORS 279C.870 are hereby incorporated by reference as if fully set forth herein. The failure of the Contractor to comply with each and every provision thereof shall be a breach of this Contract and shall entitle the Owner to pursue any remedies he deems necessary.
- B. The District is required to pay a fee to the Bureau of Labor and Industries pursuant to the provisions of ORS 279C.825 (1) (b). The fee is one-tenth of one percent of the price of this contract, but not less than \$250 nor more than \$5,000, regardless of the contract price.
  - a. Contractors working on public works projects must obtain and file with the Construction Contractors Board (CCB) a public works bond with a corporate surety authorized to do business in Oregon for the amount of \$30,000 before starting work on a contract or subcontract for a public works project, unless exempt. (Mandated by SB477 (2005)
- C. The Contractor shall be subject to any amendments to the said statutes whether occurring before or after the execution of the Contract without increase to the Contract Price.
- D. Under the provisions of ORS 279C.840, the hourly wages paid to laborers, workmen, or mechanics upon all public works of this State and upon work contemplated in this Contract, shall be not less than the prevailing rate of wage for an hour's work in the same trade or occupation in the locality within the State where such labor and work herein contemplated is to be performed, and established by the Oregon Bureau of Labor and Industries [BOLI].
  - a. All laborers, workmen or mechanics shall be paid not less than the minimum hourly rate of wage which are incorporated herein, provided, however, that nothing herein contained shall be construed to prohibit the Contractor, Subcontractor or other person doing or contracting to do the whole or any part of the work under this Contract, from paying any such laborers, workmen or mechanics wages in excess of the hourly minimum rate above specified.
- E. The Owner does not guarantee that the labor can be procured for the minimum wages set forth.
  - a. The rates of wages listed are minimums only, below which the Contractor cannot pay and they do not constitute a representation the labor can be procured for the minimum listed. It will be the responsibility of the Contractor to ascertain for himself the wages above the minimum he may have to pay.
- F. In accordance with ORS 279C.845 the Contractor shall file certified statements under oath with the Owner certifying the rate of hourly wage paid each classification of laborers, workmen, or mechanics employed upon the work by the Contractor or Subcontractor which shall be not less than the prevailing rate of wage. Such statement and any supplemental statements which may be necessary shall be filed in accordance with the practices and procedures required by the Department of Labor and Industries.
- G. In accordance with ORS 279C.850, inspections may be conducted by the Commissioner of the Bureau of Labor and Industries to confirm compliance with these laws.

- H. Copies of wage rate approvals will be furnished the awarding agency, and the Contractor (and the Prime Contractor in the case of Subcontractor) by the Industrial Statistician.
- I. Notarized certificates that the minimum wage rates have been paid the Contractor and each subcontractor shall be submitted with the Contractor's applications for payments.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

# END OF WAGE RATES SECTION

#### SECTION 012940 – CERTIFICATE OF COMPLIANCE

#### **CERTIFICATE OF COMPLIANCE**

No final payment shall be made until the Contractor shall file with the Owner, prior to acceptance of the Work, a notarized Certification of Compliance in the following form:

\*\*\*\*\*\*\*

The Contractor does hereby certify that all work has been performed and materials supplied in accordance with the drawings, specifications and Contract Documents for the above Work, and that:

No less than the prevailing rates of wages as ascertained by the governing body of the Contracting agency has been paid to laborers, workmen and mechanics employed on this Work;

There have been no unauthorized substitutes of Subcontractors; nor have any subcontracts been entered into without the names of the Subcontractors having been submitted to the Owner prior to the start of such subcontracted work;

No subcontract was assigned or transferred or performed by any Subcontractor other than the original Subcontractor, without prior notice having been submitted to the Owner together with the names of all Subcontractors;

All claims for material and labor and other service performed in connection with these specifications have been paid;

All monies due the State Industrial Accident Fund, the State Unemployment Compensation Trust Fund, the State Tax Commission, Hospital Associates and/or others have been paid.

To the best of my knowledge, no asbestos containing material has been used in the construction of this project. Material safety data sheets will be provided as requested by the Owner for all materials which may be questioned in the future.

In WITNESS WHEREOF, the undersigned has signed and sealed this instrument this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

Firm Name\_\_\_\_\_

Signature\_\_\_\_\_

Title

(Attest)

(SEAL IF BIDDER IS A CORPORATION)

As determined necessary, evidence of compliance may be required to be submitted with and made a part of this Certificate of Compliance

# END OF CERTIFICATE OF COMPLIANCE SECTION

# SECTION 012980 – CERTIFICATION OF NO ASBESTOS

# **CERTIFICATION OF NO ASBESTOS**

No final payment shall be made until the Contractor shall file with the Owner, prior to acceptance of the Work, a notarized Certification of Compliance in the following form:

\*\*\*\*\*

"TO THE BEST OF MY KNOWLEDGE NO ASBESTOS CONTAINING MATERIAL IS USED IN THE CONSTRUCTION OF THIS PROJECT. MATERIAL SAFETY DATA SHEETS WILL BE PROVIDED AS REQUESTED BY THE OWNER FOR ALL MATERIALS WHICH MAY BE QUESTIONED IN THE FUTURE."

In WITNESS WHEREOF,	, the undersigned	has signed	and sealed	I this instrument
this	-	-		

\_\_\_\_\_day of\_\_\_\_\_\_, 20\_\_\_\_,

Firm Name

Signature \_\_\_\_\_

Title

(Attest)

(SEAL IF BIDDER IS A CORPORATION)

As determined necessary, evidence of compliance may be required to be submitted with and made a part of this Certificate.

# END OF CERTIFICATION OF NO ASBESTOS SECTION

# SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

# PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. Requests for Information (RFIs).
  - 4. Project Web site.
  - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
  - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

#### 1.3 DEFINITIONS

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

# 1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. Include the following information in tabular form:
  - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.

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- 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
  - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

# 1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

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- 1. Preparation of Contractor's construction schedule.
- 2. Preparation of the schedule of values.
- 3. Installation and removal of temporary facilities and controls.
- 4. Delivery and processing of submittals.
- 5. Progress meetings.
- 6. Preinstallation conferences.
- 7. Project closeout activities.
- 8. Startup and adjustment of systems.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

#### 1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
  - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - f. Indicate required installation sequences.
    - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

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- B. Coordination Drawing Organization: Organize coordination drawings as follows:
  - 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
  - 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
  - 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
  - 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  - 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
  - 6. Mechanical and Plumbing Work: Show the following:
    - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    - c. Fire-rated enclosures around ductwork.
  - 7. Electrical Work: Show the following:
    - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
    - b. Light fixture, exit light, emergency battery pack, smoke detector, and other firealarm locations.
    - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
  - 8. Fire-Protection System: Show the following:
    - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
  - 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
  - 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
  - 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
  - 2. File Preparation Format: DWG, Version AutoCAD2010, operating in Microsoft Windows operating system.
  - 3. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
  - 4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
    - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    - b. Digital Data Software Program: Drawings are available in AutoCAD
    - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

# 1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  - 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
  - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  - 1. Project name.
  - 2. Project number.
  - 3. Date.
  - 4. Name of Contractor.
  - 5. Name of Architect.
  - 6. RFI number, numbered sequentially.
  - 7. RFI subject.
  - 8. Specification Section number and title and related paragraphs, as appropriate.
  - 9. Drawing number and detail references, as appropriate.
  - 10. Field dimensions and conditions, as appropriate.
  - 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  - 12. Contractor's signature.
  - 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716.
  - 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
  - 1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  - 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
  - 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use CSI Log Form 13.2B. Include the following:
  - 1. Project name.
  - 2. Name and address of Contractor.
  - 3. Name and address of Architect.
  - 4. RFI number including RFIs that were returned without action or withdrawn.
  - 5. RFI description.
  - 6. Date the RFI was submitted.
  - 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
  - 1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

#### 1.8 PROJECT MEETINGS

- A. General: Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect, within three days of the meeting.
- B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
  - 1. Conduct the conference to review responsibilities and personnel assignments.
  - 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, , Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Lines of communications.
    - f. Procedures for processing field decisions and Change Orders.
    - g. Procedures for RFIs.
    - h. Procedures for testing and inspecting.
    - i. Procedures for processing Applications for Payment.
    - j. Distribution of the Contract Documents.
    - k. Submittal procedures.
    - 1. Sustainable design requirements.
    - m. Preparation of record documents.
    - n. Use of the premises and existing building.
    - o. Work restrictions.
    - p. Working hours.
    - q. Owner's occupancy requirements.
    - r. Responsibility for temporary facilities and controls.
    - s. Procedures for moisture and mold control.
    - t. Procedures for disruptions and shutdowns.
    - u. Construction waste management and recycling.

- v. Parking availability.
- w. Office, work, and storage areas.
- x. Equipment deliveries and priorities.
- y. First aid.
- z. Security.
- aa. Progress cleaning.
- 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
  - 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Sustainable design requirements.
    - i. Review of mockups.
    - j. Possible conflicts.
    - k. Compatibility requirements.
    - 1. Time schedules.
    - m. Weather limitations.
    - n. Manufacturer's written instructions.
    - o. Warranty requirements.
    - p. Compatibility of materials.
    - q. Acceptability of substrates.
    - r. Temporary facilities and controls.
    - s. Space and access limitations.
    - t. Regulations of authorities having jurisdiction.
    - u. Testing and inspecting requirements.
    - v. Installation procedures.
    - w. Coordination with other work.
    - x. Required performance results.
    - y. Protection of adjacent work.
    - z. Protection of construction and personnel.
  - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

- 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Construction Manager will schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
  - 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  - 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of record documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Submittal of written warranties.
    - d. Requirements for completing sustainable design documentation.
    - e. Requirements for preparing operations and maintenance data.
    - f. Requirements for delivery of material samples, attic stock, and spare parts.
    - g. Requirements for demonstration and training.
    - h. Preparation of Contractor's punch list.
    - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    - j. Submittal procedures.
    - k. Coordination of separate contracts.
    - 1. Owner's partial occupancy requirements.
    - m. Installation of Owner's furniture, fixtures, and equipment.
    - n. Responsibility for removing temporary facilities and controls.
  - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Construction Manager will conduct progress meetings at regular intervals.
  - 1. Coordinate dates of meetings with preparation of payment requests.
  - 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

- 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
  - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - 1) Review schedule for next period.
  - b. Review present and future needs of each entity present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Resolution of BIM component conflicts.
    - 4) Status of submittals.
    - 5) Status of sustainable design documentation.
    - 6) Deliveries.
    - 7) Off-site fabrication.
    - 8) Access.
    - 9) Site utilization.
    - 10) Temporary facilities and controls.
    - 11) Progress cleaning.
    - 12) Quality and work standards.
    - 13) Status of correction of deficient items.
    - 14) Field observations.
    - 15) Status of RFIs.
    - 16) Status of proposal requests.
    - 17) Pending changes.
    - 18) Status of Change Orders.
    - 19) Pending claims and disputes.
    - 20) Documentation of information for payment requests.
- 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
  - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Construction Manager will conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
  - 1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or

performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

- 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
  - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
  - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
  - c. Review present and future needs of each contractor present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Resolution of BIM component conflicts.
    - 4) Status of submittals.
    - 5) Deliveries.
    - 6) Off-site fabrication.
    - 7) Access.
    - 8) Site utilization.
    - 9) Temporary facilities and controls.
    - 10) Work hours.
    - 11) Hazards and risks.
    - 12) Progress cleaning.
    - 13) Quality and work standards.
    - 14) Change Orders.
- 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

#### SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

#### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Start-up construction schedule.
  - 2. Contractor's construction schedule.
  - 3. Daily construction reports.
  - 4. Material location reports.
  - 5. Field condition reports.
  - 6. Special reports.
- B. Related Sections:
  - 1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
  - 2. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

#### 1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of the Project.

- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time belongs to Owner.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. PDF electronic file.
- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
  - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- C. Daily Construction Reports: Submit at weekly intervals.
- D. Material Location Reports: Submit at monthly intervals.
- E. Field Condition Reports: Submit at time of discovery of differing conditions.
- F. Special Reports: Submit at time of unusual event.

#### 1.5 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from entities involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

#### PART 2 - PRODUCTS

#### 2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
  - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
  - 4. Startup and Testing Time: Include not less than 15 days for startup and testing.
  - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and administrative procedures necessary for certification of Substantial Completion.
  - 6. Punch List and Final Completion: Include not more than 30 days for punch list and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
  - 1. Phasing: Arrange list of activities on schedule by phase.
  - 2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  - 3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  - 4. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Partial occupancy before Substantial Completion.

- e. Use of premises restrictions.
- f. Provisions for future construction.
- g. Seasonal variations.
- h. Environmental control.
- 5. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
  - a. Subcontract awards.
  - b. Submittals.
  - c. Purchases.
  - d. Mockups.
  - e. Fabrication.
  - f. Sample testing.
  - g. Deliveries.
  - h. Installation.
  - i. Tests and inspections.
  - j. Adjusting.
  - k. Curing.
  - 1. Startup and placement into final use and operation.
- 6. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
  - a. Structural completion.
  - b. Permanent space enclosure.
  - c. Completion of mechanical installation.
  - d. Completion of electrical installation.
  - e. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
  - 1. Unresolved issues.
  - 2. Unanswered RFIs.
  - 3. Rejected or unreturned submittals.
  - 4. Notations on returned submittals.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Utilize Microsoft Project, Primavera, or Prolog for Windows XP operating system.

#### 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

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

#### 2.3 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
  - 1. List of subcontractors at Project site.
  - 2. Approximate count of personnel at Project site.
  - 3. Equipment at Project site.
  - 4. Material deliveries.
  - 5. High and low temperatures and general weather conditions, including presence of rain or snow.
  - 6. Accidents.
  - 7. Meetings and significant decisions.
  - 8. Unusual events (refer to special reports).
  - 9. Stoppages, delays, shortages, and losses.
  - 10. Meter readings and similar recordings.
  - 11. Emergency procedures.
  - 12. Orders and requests of authorities having jurisdiction.
  - 13. Change Orders received and implemented.
  - 14. Construction Change Directives received and implemented.
  - 15. Services connected and disconnected.
  - 16. Equipment or system tests and startups.
  - 17. Partial completions and occupancies.
  - 18. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for

Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

#### 2.4 SPECIAL REPORTS

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

#### PART 3 - EXECUTION

#### 3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

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

END OF SECTION 013200

#### SECTION 013300 - SUBMITTAL PROCEDURES

#### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
  - 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
  - 2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
  - 3. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
  - 4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
  - 5. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

#### 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

#### 1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
  - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
  - 4. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification Section number and title.
    - c. Submittal category: Action; informational.
    - d. Name of subcontractor.
    - e. Description of the Work covered.
    - f. Scheduled date for Architect's and Construction Manager's final release or approval.
    - g. Scheduled date of fabrication.
    - h. Scheduled dates for purchasing.
    - i. Scheduled dates for installation.
    - j. Activity or event number.

#### 1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
  - 1. Architect will furnish Contractor digital data drawing files of the required Contract Drawings for use in preparing Shop Drawings.
    - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

- b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD 2010.
- c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
- d. Digital drawing files will be provided as requested through Construction Manager.
- e. The following digital data files will by furnished for each appropriate discipline:
  - 1) Floor plans.
  - 2) Reflected ceiling plans.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  - 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  - 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  - 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
  - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
  - 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
  - 1. Indicate name of firm or entity that prepared each submittal on label or title block.

- 2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
- 3. Include the following information for processing and recording action taken:
  - a. Project name.
  - b. Date.
  - c. Name of Architect.
  - d. Name of Construction Manager.
  - e. Name of Contractor.
  - f. Name of subcontractor.
  - g. Name of supplier.
  - h. Name of manufacturer.
  - i. Submittal number or other unique identifier, including revision identifier.
    - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
  - j. Number and title of appropriate Specification Section.
  - k. Drawing number and detail references, as appropriate.
  - 1. Location(s) where product is to be installed, as appropriate.
  - m. Other necessary identification.
- 4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
  - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- 5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review submittals received from sources other than Contractor.
  - a. Transmittal Form for Paper Submittals: Use AIA Document G810.
  - b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
    - 1) Project name.
    - 2) Date.
    - 3) Destination (To:).
    - 4) Source (From:).
    - 5) Name and address of Architect.
    - 6) Name of Construction Manager.
    - 7) Name of Contractor.
    - 8) Name of firm or entity that prepared submittal.
    - 9) Names of subcontractor, manufacturer, and supplier.
    - 10) Category and type of submittal.
    - 11) Submittal purpose and description.

- 12) Specification Section number and title.
- 13) Specification paragraph number or drawing designation and generic name for each of multiple items.
- 14) Drawing number and detail references, as appropriate.
- 15) Indication of full or partial submittal.
- 16) Transmittal number, numbered consecutively.
- 17) Submittal and transmittal distribution record.
- 18) Remarks.
- 19) Signature of transmitter.
- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
  - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  - 2. Name file with submittal number or other unique identifier, including revision identifier.
    - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
  - 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
  - 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name of Construction Manager.
    - e. Name of Contractor.
    - f. Name of firm or entity that prepared submittal.
    - g. Names of subcontractor, manufacturer, and supplier.
    - h. Category and type of submittal.
    - i. Submittal purpose and description.
    - j. Specification Section number and title.
    - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
    - 1. Drawing number and detail references, as appropriate.
    - m. Location(s) where product is to be installed, as appropriate.
    - n. Related physical samples submitted directly.
    - o. Indication of full or partial submittal.
    - p. Transmittal number, numbered consecutively.
    - q. Submittal and transmittal distribution record.
    - r. Other necessary identification.
    - s. Remarks.

- 5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
  - a. Project name.
  - b. Number and title of appropriate Specification Section.
  - c. Manufacturer name.
  - d. Product name.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  - 1. Note date and content of previous submittal.
  - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

#### 2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Submit electronic submittals as PDF electronic files directly to Architect via email.
    - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
  - 2. Submit electronic submittals via email as PDF electronic files.
    - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

- 3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
- 4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
- 5. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
  - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
  - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  - 5. Submit Product Data before or concurrent with Samples.
  - 6. Submit Product Data in the following format:
    - a. PDF electronic file.
    - b. Three paper copies of Product Data unless otherwise indicated. Architect will return two copies.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.

- 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
  - a. Identification of products.
  - b. Schedules.
  - c. Compliance with specified standards.
  - d. Notation of coordination requirements.
  - e. Notation of dimensions established by field measurement.
  - f. Relationship and attachment to adjoining construction clearly indicated.
  - g. Seal and signature of professional engineer if specified.
- 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
- 3. Submit Shop Drawings in the following format:
  - a. PDF electronic file.
  - b. Two opaque (bond) copies of each submittal. Architect will return one copy(ies).
  - c. Three opaque copies of each submittal. Architect will retain two copies; remainder will be returned.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
  - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  - 2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
    - e. Specification paragraph number and generic name of each item.
  - 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
  - 4. Disposition: Maintain sets of approved Samples at Project site, available for qualitycontrol comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  - 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

- a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
  - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
    - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
    - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
  - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  - 2. Manufacturer and product name, and model number if applicable.
  - 3. Number and name of room or space.
  - 4. Location within room or space.
  - 5. Submit product schedule in the following format:
    - a. PDF electronic file.
    - b. Three paper copies of product schedule or list unless otherwise indicated. Architect will return two copies.
- F. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - 1. Name of evaluation organization.
  - 2. Date of evaluation.
  - 3. Time period when report is in effect.
  - 4. Product and manufacturers' names.
  - 5. Description of product.
  - 6. Test procedures and results.
  - 7. Limitations of use.

- U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

### 2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

#### PART 3 - EXECUTION

#### 3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

#### 3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

#### END OF SECTION 013300

# MAIA® Document C106<sup>™</sup> – 2013

# **Digital Data Licensing Agreement**

**AGREEMENT** made as of the day of in the year (*In words, indicate day, month and year.*)

**BETWEEN** the Party transmitting Digital Data ("Transmitting Party"): (*Name, address and contact information, including electronic addresses*)

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

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and the Party receiving the Digital Data ("Receiving Party"): (*Name, address and contact information, including electronic addresses*)

for the following Project: (Name and location or address)

Fern Ridge School District Elmira High School 24936 Fir Grove Ln. Elmira, OR 97347

The Transmitting Party and Receiving Party agree as follows.

#### TABLE OF ARTICLES

- 1 GENERAL PROVISIONS
- 2 TRANSMISSION OF DIGITAL DATA
- 3 LICENSE CONDITIONS
- 4 LICENSING FEE OR OTHER COMPENSATION
- 5 DIGITAL DATA

#### ARTICLE 1 GENERAL PROVISIONS

**§ 1.1** The purpose of this Agreement is to grant a license from the Transmitting Party to the Receiving Party for the Receiving Party's use of Digital Data on the Project, and to set forth the license terms.

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§ 1.2 This Agreement is the entire and integrated agreement between the parties. Except as specifically set forth herein, this Agreement does not create any other contractual relationship between the parties.

§ 1.3 For purposes of this Agreement, the term Digital Data is defined to include only those items identified in Article 5 below.

§ 1.3.1 Confidential Digital Data is defined as Digital Data containing confidential or business proprietary information that the Transmitting Party designates and clearly marks as "confidential."

#### ARTICLE 2 TRANSMISSION OF DIGITAL DATA

§ 2.1 The Transmitting Party grants to the Receiving Party a nonexclusive limited license to use the Digital Data identified in Article 5 solely and exclusively to perform services for, or construction of, the Project in accordance with the terms and conditions set forth in this Agreement.

§ 2.2 The transmission of Digital Data constitutes a warranty by the Transmitting Party to the Receiving Party that the Transmitting Party is the copyright owner of the Digital Data, or otherwise has permission to transmit the Digital Data to the Receiving Party for its use on the Project in accordance with the terms and conditions of this Agreement.

§ 2.3 If the Transmitting Party transmits Confidential Digital Data, the transmission of such Confidential Digital Data constitutes a warranty to the Receiving Party that the Transmitting Party is authorized to transmit the Confidential Digital Data. If the Receiving Party receives Confidential Digital Data, the Receiving Party shall keep the Confidential Digital Data strictly confidential and shall not disclose it to any other person or entity except as set forth in Section 2.3.1.

§ 2.3.1 The Receiving Party may disclose the Confidential Digital Data as required by law or court order, including a subpoena or other form of compulsory legal process issued by a court or governmental entity. The Receiving Party may also disclose the Confidential Digital Data to its employees, consultants or contractors in order to perform services or work solely and exclusively for the Project, provided those employees, consultants and contractors are subject to the restrictions on the disclosure and use of Confidential Digital Data as set forth in this Agreement.

§ 2.4 The Transmitting Party retains its rights in the Digital Data. By transmitting the Digital Data, the Transmitting Party does not grant to the Receiving Party an assignment of those rights; nor does the Transmitting Party convey to the Receiving Party any right in the software used to generate the Digital Data.

§ 2.5 To the fullest extent permitted by law, the Receiving Party shall indemnify and defend the Transmitting Party from and against all claims arising from or related to the Receiving Party's modification to, or unlicensed use of, the Digital Data.

#### ARTICLE 3 LICENSE CONDITIONS

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The parties agree to the following conditions on the limited license granted in Section 2.1: (State below rights or restrictions applicable to the Receiving Party's use of the Digital Data, requirements for data format, transmission method or other conditions on data to be transmitted.)

Architect-Engineer of Record (AER) makes no representation as to the compatibility of the Computer Aided Drafting/Building Information Model (CAD/BIM) files with any hardware or software.

AER makes no representation regarding the accuracy, completeness, or permanence of CAD/BIM files, nor for their merchantability or fitness for a particular purpose. Addenda information or revisions made after the date indicated on the CAD/BIM files may not have been incorporated. In the event of a conflict between the AER's sealed Contract Drawings and CAD/BIM files, the sealed Contract Drawings shall govern. It is the Owner, Contractor, or Third Party's (OCT) responsibility to determine if any conflicts exist. The CAD/BIM files shall not be considered to be Contract Documents as defined by the General Conditions of the Contract for Construction.

The use of CAD/BIM files prepared by the AER shall not in any way obviate the OCT's responsibility for the proper checking and coordination of dimensions, details, member sizes and gage, and quantities of materials as required to facilitate complete and accurate fabrication and erection.

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This Agreement shall be governed by the laws of the principal place of business of the AER.

#### LICENSING FEE OR OTHER COMPENSATION **ARTICLE** 4

The Receiving Party agrees to pay the Transmitting Party the following fee or other compensation § 4.1 There is no charge to the Owner receiving Architect-Engineer generated Digital Data for its internal facility management use.

#### The Transmitting Party agrees to send the Digital Data upon receipt of the fee or other compensation as indicated in Specification Section 013333, Electronic Drawings, for the Receiving Party's use of the Digital Data::

(State the fee, in dollars, or other method by which the Receiving Party will compensate the Transmitting Party for the Receiving Party's use of the Digital Data.)

The Transmitting Party will provide the Digital Data, dated\_\_\_\_\_ for the following drawings:

Drawings were prepared on the following:

Computer Software: / Version:

#### ARTICLE 5 DIGITAL DATA

The Parties agree that the following items constitute the Digital Data subject to the license granted in Section 2.1: (Identify below, in detail, the information created or stored in digital form the parties intend to be subject to this Agreement.)

This Agreement is entered into as of the day and year first written above and will terminate upon Substantial Completion of the Project, as that term is defined in AIA Document A201<sup>TM</sup>-2007, General Conditions of the Contract for Construction, unless otherwise agreed by the parties and set forth below. (Indicate when this Agreement will terminate, if other than the date of Substantial Completion.)

**TRANSMITTING PARTY** (Signature)

**RECEIVING PARTY** (Signature)

(Printed name and title)

(*Printed name and title*)

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## **Certification of Document's Authenticity**

AIA<sup>®</sup> Document D401<sup>™</sup> – 2003

I, Erika McClain, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with this certification at 14:51:03 on 03/07/2016 under Order No. 2838859514\_1 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA<sup>®</sup> Document C106<sup>TM</sup> – 2013, Digital Data Licensing Agreement, as published by the AIA in its software, other than changes shown in the attached final document by underscoring added text and striking over deleted text.

(Signed)		 
(Title)		 
(Dated)		 

SECTION 013333 – ELECTRONIC DRAWINGS

#### 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. The Architect-Engineer, if requested, will provide the Contractor with one (1) electronic copy of the Contract Document Drawings for distribution to subcontractors and suppliers. The electronic copy will be provided in AutoCAD 2007.

#### 1.3 REFERENCES

A. A copy of the Digital Licensing Agreement is included at the end of the Section.

#### 1.4 COST

- A. For first transmittal: No cost for one copy of all drawings transmitted to Contractor in one consolidated transmittal on DVD.
- B. For second and subsequent transmittals: \$50 per sheet or \$50 per file.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013333

#### SECTION 014000 - QUALITY REQUIREMENTS

#### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

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

#### 1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified

installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

- 1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
- 2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
- 3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

### 1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

#### 1.5 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
  - 1. Indicate manufacturer and model number of individual components.
  - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data : For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
  - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.
  - 6. Number of tests and inspections required.
  - 7. Time schedule or time span for tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.

#### 1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
  - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
  - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
  - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
  - 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

#### 1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, and telephone number of testing agency.
  - 4. Dates and locations of samples and tests or inspections.

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- 5. Names of individuals making tests and inspections.
- 6. Description of the Work and test and inspection method.
- 7. Identification of product and Specification Section.
- 8. Complete test or inspection data.
- 9. Test and inspection results and an interpretation of test results.
- 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
- 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
- 12. Name and signature of laboratory inspector.
- 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
  - 1. Name, address, and telephone number of technical representative making report.
  - 2. Statement on condition of substrates and their acceptability for installation of product.
  - 3. Statement that products at Project site comply with requirements.
  - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  - 6. Statement whether conditions, products, and installation will affect warranty.
  - 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
  - 1. Name, address, and telephone number of factory-authorized service representative making report.
  - 2. Statement that equipment complies with requirements.
  - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  - 4. Statement whether conditions, products, and installation will affect warranty.
  - 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

#### 1.9 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
  - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
  - 1. Contractor responsibilities include the following:

- a. Provide test specimens representative of proposed products and construction.
- b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
- c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
- d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
- e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
- f. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
- 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
  - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
  - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 7. Demolish and remove mockups when directed unless otherwise indicated.
- L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.
- M. Room Mockups: Construct room mockups incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work. Provide room mockups of the following rooms:
  - 1. Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
#### 1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
  - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  - 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
  - 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
  - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  - 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  - 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  - 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
  - 1. Access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
  - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  - 4. Facilities for storage and field curing of test samples.
  - 5. Delivery of samples to testing agencies.
  - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
  - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar qualitycontrol services required by the Contract Documents as a component of Contractor's qualitycontrol plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
  - 1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

# 1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

- 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
- 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
- 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
- 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
- 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- 6. Retesting and reinspecting corrected work.

## PART 2 - PRODUCTS (Not Used)

# PART 3 - EXECUTION

## 3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  - 1. Date test or inspection was conducted.
  - 2. Description of the Work tested or inspected.
  - 3. Date test or inspection results were transmitted to Architect.
  - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

# 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

#### END OF SECTION 014000

#### SECTION 014110 – SAFETY PROCEDURES

#### PART 1 GENERAL

#### 1.01 **PRELIMINARY WORK**

A. Prior to the start of and during the course of the Work (above and below ground) the Contractor shall make a thorough survey of the entire work site to determine all potential hazards. Workmen shall be made aware of those hazards and shall be instructed in procedures and the use of equipment for their protection. The Contractor shall verify the location and condition ("live" or "dead") of all utilities on and near the work site and take precautions to protect his/her employees, the general public, and the property.

#### 1.02 **IMMINENT DANGER**

A. The Contractor shall be wholly responsible for any accidents (including death) occurring at any time during the progress of the work and until the final acceptance of the work by the Owner which may happen to any of his workmen or those of any Subcontractor employed on the building, or for any damage or injuries (including death) which his work and operations may cause to the work being constructed, or to existing buildings, or to any tenants and occupants of the property, or of the adjoining properties, or to the public, or to any public or private property.

#### 1.03 **SAFETY**

- A. The Contractor shall ensure that all employees, visitors, subcontractors' employees, and suppliers' employees, while on the work site, comply with the requirements of OSHA, these requirements and the safety precautions contained in the several Specifications Sections. The Contractor shall promptly and fully comply with, execute and, without separate charge thereof to the Owner, shall enforce compliance with the provisions of the Oregon State Employment Act Safety Requirements and Occupational Safety and Health Act requirements.
- B. The Contractor shall immediately advise the Owner of inspections conducted by OSHA, at the work site, and shall transmit copies of citations and violations to the Project Manager.

## 1.04 SAFETY RESPONSIBILITIES

- A. Contractor shall be responsible to:
  - 1. Ensure compliance with these requirements, OSHA requirements, and other safety requirements.
  - 2. Authorize immediate action to correct substandard safety conditions.
  - 3. Review and act to ensure compliance with safety procedures with his supervisors, subcontractors, and suppliers.

- 4. Make thorough daily safety inspections of the work site and immediately act to eliminate unsafe acts and unsafe conditions.
- 5. Investigate worksite accidents and recommend immediate corrective action.
- 6. Assist in the preparation of accident investigation and reporting procedures.
- 7. Be responsible for the control, availability, and use of safety equipment, including employee personal protective equipment.

# 1.05 **REQUEST FOR VARIANCES**

A. Requests for variances to deviate from OSHA requirements must follow the current established procedures by that Agency.

## 1.06 FAILURE TO COMPLY

A. If the project is shut down due to the Contractor's failure to comply with the requirements of OSHA or other applicable safety requirements, no part of the time loss due to any such suspension of operations or stop orders shall be made the subject of a claim for extension of time or for increased cost or damage by the Contractor.

## 1.07 **BASIC SAFETY WORK RULES**

- A. The Fern Ridge School District is committed to the safety and health of all personnel: school students and staff, construction personnel, vendors, and the general public. In our effort to make projects hazard free and provide the safest working conditions possible, we expect all construction personnel to learn and practice the following basic safe work rules. In addition to the rules listed below, there are additional site specific work rules that must be observed on this project. All applicable OSHA and Oregon OSHA codes are to be strictly followed. See your supervisor for additional information.
  - 1. All construction contractors shall develop for owner review, a safety program oriented to work in, or around, school occupied spaces: notification of planned work, safety barricades/barriers, restricted access locations, noise containment, worker conduct, noise and overhead lifts during school session, etc.
  - 2. Work shall never commence until proscribed safety barriers are in place near student occupied areas.
  - 3. Drugs, alcohol, smoking, are prohibited on school property.
  - 4. Approved and unaltered hard hats and sturdy work boots/shoes are required at all times in all work areas.
  - 5. Sleeveless shirts and short pants will not be permitted.
  - 6. Approved (Z.87. I) safety glasses/goggles eye protection shall be worn when exposed, or potentially exposed, to harmful rays, dust, chemicals, or flying particles.
  - 7. Hearing protection shall be worn in all high noise areas or while performing high noise tasks.
  - 8. Approved respiratory protection shall be worn, as required.
  - 9. Proper gloves are required when handling material that could cut, burn, bruise, or contaminate the skin.

- 10. Employees working on unguarded or unprotected work platforms 6 (six) feet or more above the ground shall wear a safety belt or harness as prescribed by OSHA.
- 11. No employee shall work on scaffolding higher than 6 (six) feet without proper guardrails and toe-boards, unless safety belts or barricades are used.
- 12. Do not climb on or work from any handrail, mid-rail or brace. Use the scaffold ladder to get on a scaffold.
- 13. Secure or cleat scaffold boards to prevent movement.
- 14. Inspect all ladders for damage or defects before use. Step ladders will only be used in the fully opened position. ♦ Extension ladders shall not be separated, ladder feet set on a secure surface, and tied off at the top.
- 15. Good housekeeping shall be practiced at all times.
- 16. Projecting nails shall be bent over or removed from all lumber on site.
- 17. Clean up spills immediately and remove oily, flammable, or combustible waste/rags to approved containers.
- 18. Access to safety and fire-fighting equipment shall be kept clear at all times. Learn how to use an extinguisher before you need it!
- 19. Gasoline equipment shall not be refueled when running.
- 20. Keep compressed gas cylinders in the upright position with caps on when not in use and secure from students.
- 21. Never enter a confined space/excavation until you check with your supervisor. Supplied air may be required.
- 22. Never enter an unshored excavation over 4 (four) feet deep unless the slopes are laid back.
- 23. Excavations will be provided with an access/egress ladder requiring no more than 25 (twenty-five) feet of travel.
- 24. Every tool is designed for a specific use inspect before you use and do not misuse/abuse.
- 25. Horseplay, fighting, gambling, cursing, offensive behavior, and fraternizing with school students and staff will not be tolerated.
- 26. All electrical extension cords shall be three wire heavy duty and not laid across traffic areas.
- 27. Tagout and lockout rules are to be strictly enforced.
- 28. Wire rope chokers, slings, chainfalls, and come-a-longs are to be inspected before use.
- 29. No person, other than the operator, shall ride on trucks, loaders, shovels or other moving equipment .
- 30. Immediately report all near misses, accidents and injuries to your supervisor. Report unsafe conditions or practices to your supervisor immediately.
- 31. HOT WORK permits are required for all flame and spark producing work.
- 32. Use "911" for emergency response for fire and injuries requiring medical attention.
- 33. All electrical/powder/air-powered equipment shall conform to the applicable OSHA code for construction .
- 34. Safety meetings shall be held each week and documented properly.
- 35. Contractors shall not allow its personnel to play sound/music devices (radios, stereos, etc.) on school property.

## PART 2 PRODUCTS

SAFETY PROCEDURES

Not Used.

# PART 3 EXECUTION

Not Used.

# END OF SAFETY PROCEDURES SECTION

SECTION 014200 - REFERENCES

## PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Cosentract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

# 1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

## 1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
  - 1. AABC Associated Air Balance Council; <u>www.aabc.com</u>.
  - 2. AAMA American Architectural Manufacturers Association; <u>www.aamanet.org</u>.
  - 3. AAPFCO Association of American Plant Food Control Officials; <u>www.aapfco.org</u>.
  - 4. AASHTO American Association of State Highway and Transportation Officials; <u>www.transportation.org</u>.
  - 5. AATCC American Association of Textile Chemists and Colorists; <u>www.aatcc.org</u>.
  - 6. ABMA American Bearing Manufacturers Association; <u>www.americanbearings.org</u>.
  - 7. ABMA American Boiler Manufacturers Association; <u>www.abma.com</u>.
  - 8. ACI American Concrete Institute; (Formerly: ACI International); <u>www.abma.com</u>.
  - 9. ACPA American Concrete Pipe Association; <u>www.concrete-pipe.org</u>.
  - 10. AEIC Association of Edison Illuminating Companies, Inc. (The); <u>www.aeic.org</u>.
  - 11. AF&PA American Forest & Paper Association; www.afandpa.org.
  - 12. AGA American Gas Association; <u>www.aga.org</u>.
  - 13. AHAM Association of Home Appliance Manufacturers; www.aham.org.
  - 14. AHRI Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
  - 15. AI Asphalt Institute; www.asphaltinstitute.org.
  - 16. AIA American Institute of Architects (The); www.aia.org.
  - 17. AISC American Institute of Steel Construction; <u>www.aisc.org</u>.
  - 18. AISI American Iron and Steel Institute; www.steel.org.
  - 19. AITC American Institute of Timber Construction; <u>www.aitc-glulam.org</u>.
  - 20. AMCA Air Movement and Control Association International, Inc.; www.amca.org.
  - 21. ANSI American National Standards Institute; <u>www.ansi.org</u>.
  - 22. AOSA Association of Official Seed Analysts, Inc.; www.aosaseed.com.
  - 23. APA APA The Engineered Wood Association; www.apawood.org.
  - 24. APA Architectural Precast Association; www.archprecast.org.
  - 25. API American Petroleum Institute; www.api.org.
  - 26. ARI Air-Conditioning & Refrigeration Institute; (See AHRI).

- 27. ARI American Refrigeration Institute; (See AHRI).
- 28. ARMA Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
- 29. ASCE American Society of Civil Engineers; www.asce.org.
- 30. ASCE/SEI American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
- 31. ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
- 32. ASME ASME International; (American Society of Mechanical Engineers); www.asme.org.
- 33. ASSE American Society of Safety Engineers (The); www.asse.org.
- 34. ASSE American Society of Sanitary Engineering; www.asse-plumbing.org.
- 35. ASTM ASTM International; <u>www.astm.org</u>.
- 36. ATIS Alliance for Telecommunications Industry Solutions; www.atis.org.
- 37. AWEA American Wind Energy Association; <u>www.awea.org</u>.
- 38. AWI Architectural Woodwork Institute; <u>www.awinet.org</u>.
- 39. AWMAC Architectural Woodwork Manufacturers Association of Canada; <u>www.awmac.com</u>.
- 40. AWPA American Wood Protection Association; <u>www.awpa.com</u>.
- 41. AWS American Welding Society; <u>www.aws.org</u>.
- 42. AWWA American Water Works Association; www.awwa.org.
- 43. BHMA Builders Hardware Manufacturers Association; www.buildershardware.com.
- 44. BIA Brick Industry Association (The); <u>www.gobrick.com</u>.
- 45. BICSI BICSI, Inc.; <u>www.bicsi.org</u>.
- 46. BIFMA BIFMA International; (Business and Institutional Furniture Manufacturer's Association); <u>www.bifma.org</u>.
- 47. BISSC Baking Industry Sanitation Standards Committee; www.bissc.org.
- 48. BWF Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
- 49. CDA Copper Development Association; www.copper.org.
- 50. CEA Canadian Electricity Association; <u>www.electricity.ca</u>.
- 51. CEA Consumer Electronics Association; www.ce.org.
- 52. CFFA Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
- 53. CFSEI Cold-Formed Steel Engineers Institute; www.cfsei.org.
- 54. CGA Compressed Gas Association; <u>www.cganet.com</u>.
- 55. CIMA Cellulose Insulation Manufacturers Association; www.cellulose.org.
- 56. CISCA Ceilings & Interior Systems Construction Association; www.cisca.org.
- 57. CISPI Cast Iron Soil Pipe Institute; <u>www.cispi.org</u>.
- 58. CLFMI Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
- 59. CPA Composite Panel Association; <u>www.pbmdf.com</u>.
- 60. CRI Carpet and Rug Institute (The); <u>www.carpet-rug.org</u>.
- 61. CRRC Cool Roof Rating Council; <u>www.coolroofs.org</u>.
- 62. CRSI Concrete Reinforcing Steel Institute; www.crsi.org.
- 63. CSA Canadian Standards Association; <u>www.csa.ca</u>.
- 64. CSA CSA International; (Formerly: IAS International Approval Services); <u>www.csa-international.org</u>.
- 65. CSI Construction Specifications Institute (The); <u>www.csinet.org</u>.
- 66. CSSB Cedar Shake & Shingle Bureau; <u>www.cedarbureau.org</u>.
- 67. CTI Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
- 68. CWC Composite Wood Council; (See CPA).
- 69. DASMA Door and Access Systems Manufacturers Association; <u>www.dasma.com</u>.

- 70. DHI Door and Hardware Institute; www.dhi.org.
- 71. ECA Electronic Components Association; (See ECIA).
- 72. ECAMA Electronic Components Assemblies & Materials Association; (See ECIA).
- 73. ECIA Electronic Components Industry Association; www.eciaonline.org.
- 74. EIA Electronic Industries Alliance; (See TIA).
- 75. EIMA EIFS Industry Members Association; <u>www.eima.com</u>.
- 76. EJMA Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
- 77. ESD ESD Association; (Electrostatic Discharge Association); www.esda.org.
- 78. ESTA Entertainment Services and Technology Association; (See PLASA).
- 79. EVO Efficiency Valuation Organization; www.evo-world.org.
- 80. FCI Fluid Controls Institute; www.fluidcontrolsinstitute.org.
- 81. FIBA Federation Internationale de Basketball; (The International Basketball Federation); <u>www.fiba.com</u>.
- 82. FIVB Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
- 83. FM Approvals FM Approvals LLC; <u>www.fmglobal.com</u>.
- 84. FM Global FM Global; (Formerly: FMG FM Global); www.fmglobal.com.
- 85. FRSA Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; <u>www.floridaroof.com</u>.
- 86. FSA Fluid Sealing Association; www.fluidsealing.com.
- 87. FSC Forest Stewardship Council U.S.; <u>www.fscus.org</u>.
- 88. GA Gypsum Association; <u>www.gypsum.org</u>.
- 89. GANA Glass Association of North America; www.glasswebsite.com.
- 90. GS Green Seal; <u>www.greenseal.org</u>.
- 91. HI Hydraulic Institute; <u>www.pumps.org</u>.
- 92. HI/GAMA Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
- 93. HMMA Hollow Metal Manufacturers Association; (See NAAMM).
- 94. HPVA Hardwood Plywood & Veneer Association; <u>www.hpva.org</u>.
- 95. HPW H. P. White Laboratory, Inc.; <u>www.hpwhite.com</u>.
- 96. IAPSC International Association of Professional Security Consultants; www.iapsc.org.
- 97. IAS International Accreditation Service; <u>www.iasonline.org</u>.
- 98. IAS International Approval Services; (See CSA).
- 99. ICBO International Conference of Building Officials; (See ICC).
- 100. ICC International Code Council; <u>www.iccsafe.org</u>.
- 101. ICEA Insulated Cable Engineers Association, Inc.; <u>www.icea.net</u>.
- 102. ICPA International Cast Polymer Alliance; www.icpa-hq.org.
- 103. ICRI International Concrete Repair Institute, Inc.; www.icri.org.
- 104. IEC International Electrotechnical Commission; www.iec.ch.
- 105. IEEE Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
- 106. IES Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
- 107. IESNA Illuminating Engineering Society of North America; (See IES).
- 108. IEST Institute of Environmental Sciences and Technology; www.iest.org.
- 109. IGMA Insulating Glass Manufacturers Alliance; www.igmaonline.org.
- 110. IGSHPA International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
- 111. ILI Indiana Limestone Institute of America, Inc.; <u>www.iliai.com</u>.
- 112. Intertek Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.

- 113. ISA International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
- 114. ISAS Instrumentation, Systems, and Automation Society (The); (See ISA).
- 115. ISFA International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
- 116. ISO International Organization for Standardization; www.iso.org.
- 117. ISSFA International Solid Surface Fabricators Association; (See ISFA).
- 118. ITU International Telecommunication Union; www.itu.int/home.
- 119. KCMA Kitchen Cabinet Manufacturers Association; www.kcma.org.
- 120. LMA Laminating Materials Association; (See CPA).
- 121. LPI Lightning Protection Institute; www.lightning.org.
- 122. MBMA Metal Building Manufacturers Association; <u>www.mbma.com</u>.
- 123. MCA Metal Construction Association; www.metalconstruction.org.
- 124. MFMA Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
- 125. MFMA Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
- 126. MHIA Material Handling Industry of America; <u>www.mhia.org</u>.
- 127. MIA Marble Institute of America; <u>www.marble-institute.com</u>.
- 128. MMPA Moulding & Millwork Producers Association; www.wmmpa.com.
- 129. MPI Master Painters Institute; <u>www.paintinfo.com</u>.
- 130. MSS Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
- 131. NAAMM National Association of Architectural Metal Manufacturers; www.naamm.org.
- 132. NACE NACE International; (National Association of Corrosion Engineers International); www.nace.org.
- 133. NADCA National Air Duct Cleaners Association; www.nadca.com.
- 134. NAIMA North American Insulation Manufacturers Association; www.naima.org.
- 135. NBGQA National Building Granite Quarries Association, Inc.; www.nbgga.com.
- 136. NBI New Buildings Institute; www.newbuildings.org.
- 137. NCAA National Collegiate Athletic Association (The); www.ncaa.org.
- 138. NCMA National Concrete Masonry Association; www.ncma.org.
- 139. NEBB National Environmental Balancing Bureau; www.nebb.org.
- 140. NECA National Electrical Contractors Association; www.necanet.org.
- 141. NeLMA Northeastern Lumber Manufacturers Association; www.nelma.org.
- 142. NEMA National Electrical Manufacturers Association; <u>www.nema.org</u>.
- 143. NETA InterNational Electrical Testing Association; www.netaworld.org.
- 144. NFHS National Federation of State High School Associations; www.nfhs.org.
- 145. NFPA National Fire Protection Association; www.nfpa.org.
- 146. NFPA NFPA International; (See NFPA).
- 147. NFRC National Fenestration Rating Council; www.nfrc.org.
- 148. NHLA National Hardwood Lumber Association; www.nhla.com.
- 149. NLGA National Lumber Grades Authority; www.nlga.org.
- 150. NOFMA National Oak Flooring Manufacturers Association; (See NWFA).
- 151. NOMMA National Ornamental & Miscellaneous Metals Association; www.nomma.org.
- 152. NRCA National Roofing Contractors Association; <u>www.nrca.net</u>.
- 153. NRMCA National Ready Mixed Concrete Association; www.nrmca.org.
- 154. NSF NSF International; <u>www.nsf.org</u>.
- 155. NSPE National Society of Professional Engineers; <u>www.nspe.org</u>.
- 156. NSSGA National Stone, Sand & Gravel Association; <u>www.nssga.org</u>.
- 157. NTMA National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.

- 158. NWFA National Wood Flooring Association; www.nwfa.org.
- 159. PCI Precast/Prestressed Concrete Institute; www.pci.org.
- 160. PDI Plumbing & Drainage Institute; <u>www.pdionline.org</u>.
- 161. PLASA PLASA; (Formerly: ESTA Entertainment Services and Technology Association); www.plasa.org.
- 162. RCSC Research Council on Structural Connections; www.boltcouncil.org.
- 163. RFCI Resilient Floor Covering Institute; www.rfci.com.
- 164. RIS Redwood Inspection Service; <u>www.redwoodinspection.com</u>.
- 165. SAE SAE International; <u>www.sae.org</u>.
- 166. SCTE Society of Cable Telecommunications Engineers; www.scte.org.
- 167. SDI Steel Deck Institute; www.sdi.org.
- 168. SDI Steel Door Institute; www.steeldoor.org.
- 169. SEFA Scientific Equipment and Furniture Association (The); www.sefalabs.com.
- 170. SEI/ASCE Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
- 171. SIA Security Industry Association; www.siaonline.org.
- 172. SJI Steel Joist Institute; www.steeljoist.org.
- 173. SMA Screen Manufacturers Association; www.smainfo.org.
- 174. SMACNA Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
- 175. SMPTE Society of Motion Picture and Television Engineers; <u>www.smpte.org</u>.
- 176. SPFA Spray Polyurethane Foam Alliance; <u>www.sprayfoam.org</u>.
- 177. SPIB Southern Pine Inspection Bureau; www.spib.org.
- 178. SPRI Single Ply Roofing Industry; www.spri.org.
- 179. SRCC Solar Rating & Certification Corporation; www.solar-rating.org.
- 180. SSINA Specialty Steel Industry of North America; www.ssina.com.
- 181. SSPC SSPC: The Society for Protective Coatings; www.sspc.org.
- 182. STI Steel Tank Institute; www.steeltank.com.
- 183. SWI Steel Window Institute; <u>www.steelwindows.com</u>.
- 184. SWPA Submersible Wastewater Pump Association; <u>www.swpa.org</u>.
- 185. TCA Tilt-Up Concrete Association; www.tilt-up.org.
- 186. TCNA Tile Council of North America, Inc.; www.tileusa.com.
- 187. TEMA Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
- 188. TIA Telecommunications Industry Association (The); (Formerly: TIA/EIA Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
- 189. TIA/EIA Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
- 190. TMS The Masonry Society; www.masonrysociety.org.
- 191. TPI Truss Plate Institute; www.tpinst.org.
- 192. TPI Turfgrass Producers International; www.turfgrasssod.org.
- 193. TRI Tile Roofing Institute; www.tileroofing.org.
- 194. UL Underwriters Laboratories Inc.; www.ul.com.
- 195. UNI Uni-Bell PVC Pipe Association; www.uni-bell.org.
- 196. USAV USA Volleyball; www.usavolleyball.org.
- 197. USGBC U.S. Green Building Council; www.usgbc.org.
- 198. USITT United States Institute for Theatre Technology, Inc.; www.usitt.org.
- 199. WASTEC Waste Equipment Technology Association; www.wastec.org.
- 200. WCLIB West Coast Lumber Inspection Bureau; www.wclib.org.
- 201. WCMA Window Covering Manufacturers Association; www.wcmanet.org.

- 202. WDMA Window & Door Manufacturers Association; <u>www.wdma.com</u>.
- 203. WI Woodwork Institute; <u>www.wicnet.org</u>.
- 204. WSRCA Western States Roofing Contractors Association; www.wsrca.com.
- 205. WWPA Western Wood Products Association; <u>www.wwpa.org</u>.
- C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
  - 1. DIN Deutsches Institut fur Normung e.V.; <u>www.din.de</u>.
  - 2. IAPMO International Association of Plumbing and Mechanical Officials; <u>www.iapmo.org</u>.
  - 3. ICC International Code Council; <u>www.iccsafe.org</u>.
  - 4. ICC-ES ICC Evaluation Service, LLC; <u>www.icc-es.org</u>.
- D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
  - 1. COE Army Corps of Engineers; <u>www.usace.army.mil</u>.
  - 2. CPSC Consumer Product Safety Commission; <u>www.cpsc.gov</u>.
  - 3. DOC Department of Commerce; National Institute of Standards and Technology; <u>www.nist.gov</u>.
  - 4. DOD Department of Defense; <u>www.quicksearch.dla.mil</u>.
  - 5. DOE Department of Energy; <u>www.energy.gov</u>.
  - 6. EPA Environmental Protection Agency; <u>www.epa.gov</u>.
  - 7. FAA Federal Aviation Administration; <u>www.faa.gov</u>.
  - 8. FG Federal Government Publications; <u>www.gpo.gov</u>.
  - 9. GSA General Services Administration; <u>www.gsa.gov</u>.
  - 10. HUD Department of Housing and Urban Development; <u>www.hud.gov</u>.
  - 11. LBL Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; <u>www.eetd.lbl.gov</u>.
  - 12. OSHA Occupational Safety & Health Administration; www.osha.gov.
  - 13. SD Department of State; <u>www.state.gov</u>.
  - 14. TRB Transportation Research Board; National Cooperative Highway Research Program; The National Academies; <u>www.trb.org</u>.
  - 15. USDA Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; <u>www.ars.usda.gov</u>.
  - 16. USDA Department of Agriculture; Rural Utilities Service; <u>www.usda.gov</u>.
  - 17. USDJ Department of Justice; Office of Justice Programs; National Institute of Justice; <u>www.ojp.usdoj.gov</u>.
  - 18. USP U.S. Pharmacopeial Convention; www.usp.org.
  - 19. USPS United States Postal Service; <u>www.usps.com</u>.
- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

- 1. CFR Code of Federal Regulations; Available from Government Printing Office; <u>www.gpo.gov/fdsys</u>.
- 2. DOD Department of Defense; Military Specifications and Standards; Available from DLA Document Services; <u>www.quicksearch.dla.mil</u>.
- 3. DSCC Defense Supply Center Columbus; (See FS).
- 4. FED-STD Federal Standard; (See FS).
- 5. FS Federal Specification; Available from DLA Document Services; <u>www.quicksearch.dla.mil</u>.
  - a. Available from Defense Standardization Program; <u>www.dsp.dla.mil</u>.
  - b. Available from General Services Administration; <u>www.gsa.gov</u>.
  - c. Available from National Institute of Building Sciences/Whole Building Design Guide; <u>www.wbdg.org/ccb</u>.
- 6. MILSPEC Military Specification and Standards; (See DOD).
- 7. USAB United States Access Board; <u>www.access-board.gov</u>.
- 8. USATBCB U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
  - 1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; <u>www.bearhfti.ca.gov</u>.
  - 2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; <u>www.calregs.com</u>.
  - 3. CDHS; California Department of Health Services; (See CDPH).
  - 4. CDPH; California Department of Public Health; Indoor Air Quality Program; <u>www.cal-iaq.org</u>.
  - 5. CPUC; California Public Utilities Commission; <u>www.cpuc.ca.gov</u>.
  - 6. SCAQMD; South Coast Air Quality Management District; <u>www.aqmd.gov</u>.
  - 7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

# PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

## END OF SECTION 014200

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

#### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections include the following:
  - 1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
  - 2. Division 01 Section "Execution" for progress cleaning requirements.
  - 3. Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
  - 4. Division 31 Section "Pest Control" for pest control.

#### 1.3 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

#### 1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.
  - 1. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- D. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
  - 1. Locations of dust-control partitions at each phase of the work.
  - 2. HVAC system isolation schematic drawing.
  - 3. Location of proposed air filtration system discharge.
  - 4. Other dust-control measures.
  - 5. Waste management plan.

# 1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

# 1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

## PART 2 - PRODUCTS

# 2.1 MATERIALS

A. Pavement: Comply with Division 32 Section "Asphalt Paving" and / or Section "Concrete Paving."

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- B. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.
- C. Portable Chain-Link Fencing: Minimum 2-inch, 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide concrete orgalvanized steel bases for supporting posts.
- D. Wood Enclosure Fence: Plywood, 6 feet high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.
- E. Lumber and Plywood: Comply with requirements in Division 06 Section "Rough Carpentry."
- F. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.
- G. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- H. Paint: Comply with requirements in Division 09 painting Sections.

## 2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Owner will assign General Contractor one room within each existing facility to use as a field office. Furnish and equip the room as follows:
  - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  - 2. Conference room furniture to accommodate meetings of 10 individuals.
  - 3. Drinking water.
  - 4. Coffee machine and supplies.
  - 5. Wired data connections and power connections of sufficient quantity for use by contractor, architect, and owner, supporting electronic communication service as indicated in Part 3.
  - 6. Project computers should be capable of supporting Microsoft Office: Provide Project, Word and Excel PDF reader/writer files and AutoCAD. Project computers should be supplied with sufficient networking to connect to the provided data lines. Computer to have a minimum 256MB RAM, 20GB hard disk.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  - 1. Store combustible materials apart from building.

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#### 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.

## PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work and Owner's use of the site. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

# 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

- E. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  - 1. Install electric power service overhead or underground.
  - 2. Connect temporary service to Owner's existing power source, as directed by Owner.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
  - 2. Install lighting for Project identification sign.
- I. Telephone Service: Provide mobile cellular telephone access / service for construction personnel. Require each subcontractor to provide mobile cellular telephone access / service for their personnel.
  - 1. At the field office, post a list of important telephone numbers.
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office.
    - d. Architect's office.
    - e. Engineers' offices.
    - f. Owner's office.
    - g. Principal subcontractors' field and home offices.
    - h. All site phone lines.
- J. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.
  - 1. Provide DSL or service with one data port and Cat 5 wiring to each computer station in all field offices.
  - 2. The Contractor shall provide an e-mail account for the duration of the project, commencing from the time job site offices are established to post final completion.

#### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  - 1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
  - 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
  - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
  - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31 Section "Earth Moving."
  - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
  - 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section "Asphalt Paving."
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
  - 2. Remove snow and ice as required to minimize accumulations.
- F. Project Identification and Temporary Signs: Provide Project identification and other signs. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
  - 1. Provide temporary, directional signs for construction personnel and visitors.
  - 2. Maintain and touchup signs so they are legible at all times.
- G. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

#### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  - 1. Comply with work restrictions specified in Division 01 Section "Summary."
- B. Temporary Erosion and Sedimentation Control: Comply with requirements indicated on drawings and as specified in Division 31 Section "Site Clearing."
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Tree and Plant Protection: Comply with requirements specified in Division 01 Section "Temporary Tree and Plant Protection."
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
  - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.
- G. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

- 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- J. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
  - 1. Prohibit smoking in construction areas.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

#### 3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  - 1. Protect porous materials from water damage.
  - 2. Protect stored and installed material from flowing or standing water.
  - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
  - 4. Remove standing water from decks.
  - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  - 2. Keep interior spaces reasonably clean and protected from water damage.
  - 3. Periodically collect and remove waste containing cellulose or other organic matter.
  - 4. Discard or replace water-damaged material.
  - 5. Do not install material that is wet.
  - 6. Discard, replace or clean stored or installed material that begins to grow mold.
  - 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
  - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.

- 2. Use permanent HVAC system to control humidity.
- 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
  - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
  - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
  - c. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

#### 3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  - 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  - 3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

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END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

#### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
  - 1. Division 00 Section "Alternates" for products selected under an alternate.
  - 2. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
  - 3. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

#### 1.3 DEFINITIONS

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

designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

D. Product List: A list prepared by the Contractor indicating that the Contractor is submitting the exact product specified or otherwise indicated on the Drawings.

## 1.4 PRODUCT LIST

- A. Product List is required as a condition of acceptance of Contractor's initial Application for Payment. The submitted and reviewed product list may serve in lieu of product literature and samples when the following criteria are met for products incorporated in the work:
  - 1. Contractor provides exact brand, model number finish and color specified or indicated on the drawings or schedules.
    - a. Requests for color, finish or texture samples may be requested as indicated in individual specification sections.
    - b. Submit product literature and samples for products specified or indicated on the drawings or schedules if required in the individual sections the specifications.
    - c. Maintain samples on site for products indicated in the Product List.
- B. Full submittal is required for shop drawings regardless of whether specified or indicated item included on the Product List and is provided by Contractor.
- C. Full submittal is required for acceptable manufacturers, indicated in the documents, whose products may or may not have been indicated by exact make or model number.
- D. Record relevant information on the Product List. Include specifications section article and paragraph number; and product manufacturer, name and model number. Include finishes and colors as applicable for products specified.
  - 1. Provide list in tabular format, with individual columns indicating all of the items above. Include two blank columns for the use of the architect.
- E. Review by the architect will not be performed for items supplied by the Contractor (such as product literature, etc.) for confirmation purposes only.
- F. Review by the architect will not be performed for Product Literature and Samples for specified items indicated on the Product list unless review of such items is specified in the individual specification sections or on the drawings. Submittals of products that have been included on the Product List will be returned to the Contractor without review.
- G. Full submittal (product literature samples, reports shop drawings) is required for specified items that have been discontinued and have been replaced by another item by the manufacturer, or which have been materially changed by the manufacturer, since the Contractor's bid was received or contract awarded. This includes, but is not limited to, discontinued finishes or colors.
- H. At the request of the architect, full submittal may be required for items with critical dimensions or tolerances requiring coordination with other pieces of the work.

- I. Submittal requirements for Product List: prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
  - 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
  - 2. Form: Tabulate information for each product under the following column headings:
    - a. Specification Section number and title.
    - b. Generic name used in the Contract Documents.
    - c. Proprietary name, model number, and similar designations.
    - d. Manufacturer's name and address.
    - e. Supplier's name and address.
    - f. Installer's name and address.
    - g. Projected delivery date or time span of delivery period.
    - h. Identification of items that require early submittal approval for scheduled delivery date.

### 1.5 SUBMITTALS

- A. Product List: Submit Product List, in accordance with Part 1 article "Product List." Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
  - 1. Initial Submittal: Within 30 days after date of commencement of the Work, but no later than the initial application for payment, submit 1 pdf format file of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
    - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
  - 2. Completed List: Within 60 days after date of commencement of the Work, but no later than the second application for payment, submit 1 pdf format copy of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
  - 3. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.
- B. Pre-Bid and Post-Award Substitution Requests: Reference Instructions to Bidders for additional requirements prior to Contract award and the General Conditions of the Contract after Contract award. Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use CSI Form 13.1A.

- 2. Pre-Bid Documentation: Show compliance with requirements for substitutions and the following, as applicable:
  - a. Statement indicating why specified material or product cannot be provided.
  - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
  - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
  - i. Bidder's (if pre-bid) or Contractor's (if post-award) certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
- 3. Post-Award Substitution requests: In addition to the information required above under "Pre-Bid Documentation," provide the following for Post-Award substitutions:
  - a. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
  - b. Cost information, including a proposal of change, if any, in the Contract Sum.
  - c. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- 4. Architect's Action for pre-bid substitution request: Architect will review substitution requests if received at the offices of the Architect before the number of days stipulated in the "Instructions to Bidders" prior to the date scheduled to receive bids, or, if not stipulated, no later than 10 days prior to the bid date. Substitution requests received after the date or number of days indicated will not be reviewed.
  - a. Substitutions that have been reviewed and accepted for the consideration of all bidders will be included in Addenda to the Bid Documents. Manufacturers or products indicated in substitution requests that are not included in the addenda for the project shall be considered as not accepted.
- 5. Architect's Action for Post-Award substitution request: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of

proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

- a. Form of Acceptance: Change Order.
- b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- 6. Substitution requests prior to bid date may originate directly from the General Contractor, or from a prospective supplier or subcontractor. Subsequent, post-bid substitution requests shall be submitted through the Contractor and will not be accepted through any other source.
- 7. Reference Part 2 Article "Product Substitutions" for acceptance criteria.
- C. Comparable Product Requests: Submit one copy of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
    - a. Form of Approval: As specified in Division 1 Section "Submittal Procedures."
    - b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.
  - 2. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

## 1.6 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
  - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

# 1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:

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

# C. Storage:

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

# 1.8 **PRODUCT WARRANTIES**

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  - 1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
  - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
  - 3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

#### PART 2 - PRODUCTS

#### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
  - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  - 4. Where products are accompanied by the term "as selected," Architect will make selection.
  - 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
  - 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
  - 7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
  - 1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
  - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
  - 3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
  - 4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
  - 5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
  - 6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
  - 7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.

- 8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
- 9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
- 10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
  - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
  - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

# 2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider Pre-bid requests for substitution as indicated in Part 1 Article "Submittals." Architect will consider post-award requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
  - 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
  - 2. Requested substitution does not require extensive revisions to the Contract Documents.
  - 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - 4. Substitution request is fully documented and properly submitted.
  - 5. Requested substitution will not adversely affect Contractor's Construction Schedule.

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- 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
- 7. Requested substitution is compatible with other portions of the Work.
- 8. Requested substitution has been coordinated with other portions of the Work.
- 9. Requested substitution provides specified warranty.
- 10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- 11. The availability of local maintenance service for the requested substitution is equivalent or superior to the specified item.
- 12. The specified product has been discontinued or has been replaced by a superior product.
- 13. The specified product will not fit within the designated space.
- C. Additional conditions for the consideration of post-award substitution requests: In addition the conditions indicated in other paragraphs of this article above, the Architect will consider Contractor's request for substitution when the following additional conditions are satisfied. If the following conditions, along with those indicated in Paragraph entitled "Conditions" of this article above, are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements.
  - 1. Requested substitution will not adversely affect Contractor's construction schedule.
  - 2. The substitution may be requested when subsequent information discloses the inability of the specified product to perform properly or to fit in the designated space.
  - 3. The substitution may be due to the manufacturer's or fabricator's refusal to certify or guarantee performance of the specified product as required.
  - 4. The specified product cannot be delivered without delay to the project.
  - 5. Specified product is unavailable through no fault of the Contractor. Contractor delay in ordering an available specified product does not relieve the Contractor from providing the originally specified product, and does not relieve the contractor from timely completion of the Work.
- D. Substitutions will not be considered when:
  - 1. They are indicated or implied on shop drawing or product data submittals.
  - 2. They are indicated or implied on requests for information, or a similar document.
  - 3. Acceptance will require substantial revision of contract documents, changes to or resubmittal of permits, add costs or add time.

# 2.3 COMPARABLE PRODUCTS

- A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
  - 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  - 3. Evidence that proposed product provides specified warranty.

- 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
- 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

#### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Installation of the Work.
  - 3. Cutting and patching.
  - 4. Coordination of Owner-installed products.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
  - 8. Correction of the Work.
- B. Related Sections:
  - 1. Division 01 Section "Submittal Procedures" for submitting surveys.
  - 2. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
  - 3. Division 07 Section "Penetration Firestopping" for patching penetrations in fire-rated construction.

#### 1.3 DEFINITIONS

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

#### 1.4 QUALITY ASSURANCE

A. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.
PART 2 - PRODUCTS

- 2.1 MATERIALS
  - A. General: Comply with requirements specified in other Sections.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 PREPARATION

A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before

fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

# 3.3 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
  - 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and

items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.4 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Utilize containers intended for holding waste materials of type to be stored.
  - 4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.5 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

#### 3.6 PROTECTION OF INSTALLED CONSTRUCTION

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

#### 3.7 CORRECTION OF THE WORK

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

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

END OF SECTION 017300

# SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Salvaging nonhazardous demolition and construction waste.
  - 2. Recycling nonhazardous demolition and construction waste.
  - 3. Disposing of nonhazardous demolition and construction waste.

#### B. Related Sections:

1. Division 04 Section "Unit Masonry" for disposal requirements for masonry waste.

### 1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

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### 1.4 PERFORMANCE REQUIREMENTS

- A. General: The Project Goal (but not required) is to achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:
  - 1. Demolition Waste:
    - a. Asphaltic concrete paving.
    - b. Concrete.
    - c. Concrete reinforcing steel.
    - d. Brick.
    - e. Concrete masonry units.
    - f. Wood studs.
    - g. Wood joists.
    - h. Plywood and oriented strand board.
    - i. Wood paneling.
    - j. Wood trim.
    - k. Structural and miscellaneous steel.
    - l. Rough hardware.
    - m. Roofing.
    - n. Insulation.
    - o. Doors and frames.
    - p. Door hardware.
    - q. Windows.
    - r. Glazing.
    - s. Metal studs.
    - t. Gypsum board.
    - u. Acoustical tile and panels.
    - v. Carpet.
    - w. Carpet pad.
    - x. Demountable partitions.
    - y. Equipment.
    - z. Cabinets.
    - aa. Plumbing fixtures.
    - bb. Piping.
    - cc. Supports and hangers.
    - dd. Valves.
    - ee. Sprinklers.
    - ff. Mechanical equipment.
    - gg. Refrigerants.
    - hh. Electrical conduit.
    - ii. Copper wiring.
    - jj. Lighting fixtures.
    - kk. Lamps.
    - ll. Ballasts.
    - mm. Electrical devices.
    - nn. Switchgear and panelboards.

- oo. Transformers.
- 2. Construction Waste:
  - a. Site-clearing waste.
  - b. Masonry and CMU.
  - c. Lumber.
  - d. Wood sheet materials.
  - e. Wood trim.
  - f. Metals.
  - g. Roofing.
  - h. Insulation.
  - i. Carpet and pad.
  - j. Gypsum board.
  - k. Piping.
  - 1. Electrical conduit.
  - m. Packaging: Regardless of salvage/recycle goal indicated in paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
    - 1) Paper.
    - 2) Cardboard.
    - 3) Boxes.
    - 4) Plastic sheet and film.
    - 5) Polystyrene packaging.
    - 6) Wood crates.
    - 7) Plastic pails.

### 1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use [Form CWM-7 for construction waste] [and] [Form CWM-8 for demolition waste]. Include the following information:
  - 1. Material category.
  - 2. Generation point of waste.
  - 3. Total quantity of waste in tons (tonnes).
  - 4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
  - 5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
  - 6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
  - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Qualification Data: For waste management coordinator.

# 1.7 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of Projects with similar requirements.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
  - 1. Review and discuss waste management plan including responsibilities of waste management coordinator.
  - 2. Review requirements for documenting quantities of each type of waste and its disposition.
  - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
  - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
  - 5. Review waste management requirements for each trade.

# 1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate

quantities by weight or volume, but use same units of measure throughout waste management plan.

- B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
  - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
  - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
  - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
  - 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
  - 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
  - 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

# PART 2 - PRODUCTS (Not Used)

# PART 3 - EXECUTION

# 3.1 PLAN IMPLEMENTATION

- A. General: Implement the waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
  - 1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
  - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
  - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
  - 2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

# 3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Sale and Donation: Not permitted on Project site.

# 3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
  - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - a. Inspect containers and bins for contamination and remove contaminated materials if found.
  - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
  - 4. Store components off the ground and protect from the weather.
  - 5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

# 3.4 RECYCLING DEMOLITION WASTE

- A. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

- 1. Pulverize concrete to maximum 4-inch size or Crush concrete and screen to comply with requirements in Division 31 Section "Earth Moving" for use as satisfactory soil for fill or subbase.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
  - 1. Pulverize masonry to maximum 4-inch size or Crush masonry and screen to comply with requirements in Division 31 Section "Earth Moving" for use as satisfactory soil for fill or subbase.
  - 2. Clean and stack undamaged, whole masonry units on wood pallets.
- D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- E. Metals: Separate metals by type.
  - 1. Structural Steel: Stack members according to size, type of member, and length.
  - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- F. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- G. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- H. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- I. Carpet: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
  - 1. Store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- J. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- K. Conduit: Reduce conduit to straight lengths and store by type and size.

# 3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
  - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
  - 2. Polystyrene Packaging: Separate and bag materials.

- 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
- 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Site-Clearing Wastes: Chip brush, branches, and trees at landfill facility.
  - 1. Comply with requirements in Division 32 Section "Plants" for use of chipped organic waste as organic mulch.
- C. Wood Materials:
  - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
  - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
    - a. Comply with requirements in Division 32 Section "Plants." for use of clean sawdust as organic mulch.
- D. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
  - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
    - a. Comply with requirements in Division 32 Section "Plants." for use of clean ground gypsum board as inorganic soil amendment.

#### 3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

#### END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

# PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

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

# 1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

# 1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

# 1.5 SUBSTANTIAL COMPLETION PROCEDURES

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

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
  - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
  - 5. Submit test/adjust/balance records.
  - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Advise Owner of pending insurance changeover requirements.
  - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  - 3. Complete startup and testing of systems and equipment.
  - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
  - 6. Advise Owner of changeover in heat and other utilities.
  - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  - 9. Complete final cleaning requirements, including touchup painting.
  - 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of

unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

- 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
- 2. Results of completed inspection will form the basis of requirements for final completion.

# 1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
  - 1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
  - 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  - 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
  - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

# 1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
  - 1. Organize list of spaces in sequential order.
  - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  - 3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Page number.

- 4. Submit list of incomplete items in the following format:
  - a. MS Excel electronic file. Architect will return annotated file.

### 1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
  - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
  - 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

#### PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

### PART 3 - EXECUTION

# 3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.
    - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.
    - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
    - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - k. Remove labels that are not permanent.
    - 1. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
    - q. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

# 3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
  - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
  - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

# SECTION 017823 - OPERATION AND MAINTENANCE DATA

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Emergency manuals.
  - 3. Operation manuals for systems, subsystems, and equipment.
  - 4. Product maintenance manuals.
  - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
  - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

# 1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

# 1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:

#### OPERATION AND MAINTENANCE DATA

- 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
  - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
  - b. Enable inserted reviewer comments on draft submittals.
- 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

# PART 2 - PRODUCTS

# 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
  - 1. List of documents.
  - 2. List of systems.
  - 3. List of equipment.
  - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to

ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

### 2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name and contact information for Contractor.
  - 6. Name and contact information for Construction Manager.
  - 7. Name and contact information for Architect.
  - 8. Name and contact information for Commissioning Authority.
  - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
  - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so

that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
  - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
  - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment as needed.
  - 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
  - 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

# 2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
  - 1. Type of emergency.
  - 2. Emergency instructions.
  - 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
  - 1. Fire.
  - 2. Flood.
  - 3. Gas leak.

- 4. Water leak.
- 5. Power failure.
- 6. Water outage.
- 7. System, subsystem, or equipment failure.
- 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
  - 1. Instructions on stopping.
  - 2. Shutdown instructions for each type of emergency.
  - 3. Operating instructions for conditions outside normal operating limits.
  - 4. Required sequences for electric or electronic systems.
  - 5. Special operating instructions and procedures.

## 2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  - 2. Performance and design criteria if Contractor has delegated design responsibility.
  - 3. Operating standards.
  - 4. Operating procedures.
  - 5. Operating logs.
  - 6. Wiring diagrams.
  - 7. Control diagrams.
  - 8. Piped system diagrams.
  - 9. Precautions against improper use.
  - 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
  - 1. Product name and model number. Use designations for products indicated on Contract Documents.
  - 2. Manufacturer's name.
  - 3. Equipment identification with serial number of each component.
  - 4. Equipment function.
  - 5. Operating characteristics.
  - 6. Limiting conditions.
  - 7. Performance curves.
  - 8. Engineering data and tests.
  - 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:

#### OPERATION AND MAINTENANCE DATA

- 1. Startup procedures.
- 2. Equipment or system break-in procedures.
- 3. Routine and normal operating instructions.
- 4. Regulation and control procedures.
- 5. Instructions on stopping.
- 6. Normal shutdown instructions.
- 7. Seasonal and weekend operating instructions.
- 8. Required sequences for electric or electronic systems.
- 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

### 2.5 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

#### 2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

### PART 3 - EXECUTION

### 3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original project record documents as part of operation and maintenance manuals.
  - 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."

G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

### SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
- B. Related Sections include the following:
  - 1. Division 01 Section "Closeout Procedures" for general closeout procedures.
  - 2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 3. Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

# 1.3 SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set of Record Prints marked up or posted with addenda, RFI's, ASI's and contract modifications.
- B. Record Specifications: Submit one copy of Project's Specifications, marked up or posted with addenda, RFI's, ASI's and contract modifications.

### PART 2 - PRODUCTS

### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
  - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data,

whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
- b. Accurately record information in an understandable drawing technique.
- c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
- 2. Content: Types of items requiring marking include, but are not limited to, the following:
  - a. Dimensional changes to Drawings.
  - b. Revisions to details shown on Drawings.
  - c. Depths of foundations below first floor.
  - d. Locations and depths of underground utilities.
  - e. Revisions to routing of piping and conduits.
  - f. Revisions to electrical circuitry.
  - g. Actual equipment locations.
  - h. Duct size and routing.
  - i. Locations of concealed internal utilities.
  - j. Changes made by Change Order or Construction Change Directive.
  - k. Changes made following Architect's written orders.
  - 1. Details not on the original Contract Drawings.
  - m. Field records for variable and concealed conditions.
  - n. Record information on the Work that is shown only schematically.
- 3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
- 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
- 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing Record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
  - 1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
  - 2. Consult Architect and Construction Manager for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared Record Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

# 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  - 4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
  - 5. Note related Change Orders and Record Drawings where applicable.

# 2.3 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

# PART 3 - EXECUTION

# 3.1 RECORDING AND MAINTENANCE

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

END OF SECTION 017839

### SECTION 017900 - DEMONSTRATION AND TRAINING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Related Sections include the following:
  - 1. Division 01 Section "Project Management and Coordination" for requirements for preinstruction conferences.
  - 2. Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections.

#### 1.3 SUBMITTALS

- A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. At completion of training, submit one complete training manual(s) for Owner's use.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

### 1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

# 1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

# PART 2 - PRODUCTS

### 2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  - 2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Operations manuals.
    - c. Maintenance manuals.
    - d. Project Record Documents.
    - e. Identification systems.
    - f. Warranties and bonds.

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- g. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
  - a. Instructions on meaning of warnings, trouble indications, and error messages.
  - b. Instructions on stopping.
  - c. Shutdown instructions for each type of emergency.
  - d. Operating instructions for conditions outside of normal operating limits.
  - e. Sequences for electric or electronic systems.
  - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - 1. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
- 8. Repairs: Include the following:

- a. Diagnosis instructions.
- b. Repair instructions.
- c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
- d. Instructions for identifying parts and components.
- e. Review of spare parts needed for operation and maintenance.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

#### 3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
  - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
  - 3. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule training with Owner through Construction Manager, with at least seven days' advance notice.
- C. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral performance-based test.
- D. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION

### 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. Demolition and removal of selected portions of building or structure.
  - 2. Demolition and removal of selected site elements.
  - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
  - 2. Section 017300 "Execution" for cutting and patching procedures.

### 1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

#### 1.4 MATERIALS OWNERSHIP

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

## 1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
  - 1. Inspect and discuss condition of construction to be selectively demolished.
  - 2. Review structural load limitations of existing structure.
  - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  - 5. Review areas where existing construction is to remain and requires protection.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- D. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
  - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
  - 4. Use of elevator and stairs.
  - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

## 1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

### 1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

## 1.9 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
  - 1. Before selective demolition, Owner will remove the following items:
    - a. Library materials
    - b. Classroom materials in affected areas.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. Hazardous materials will be removed by Owner before start of the Work.
  - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
  - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
  - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
  - 3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

- F. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.
- G. Storage or sale of removed items or materials on-site is not permitted.
- H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

#### 1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

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

## PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
  - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
  - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
  - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
  - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

# 3.2 PREPARATION

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

## 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

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

g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

## 3.4 **PROTECTION**

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
  - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

## 3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  - 5. Maintain fire watch during and for at least 2 hours after flame-cutting operations.

- 6. Maintain adequate ventilation when using cutting torches.
- 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
- 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
- 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic. In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling" as specified in Section 024296 "Historic Removal and Dismantling."
- D. Removed and Salvaged Items:
  - 1. Clean salvaged items.
  - 2. Pack or crate items after cleaning. Identify contents of containers.
  - 3. Store items in a secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area designated by Owner.
  - 5. Protect items from damage during transport and storage.
- E. Removed and Reinstalled Items:
  - 1. Clean and repair items to functional condition adequate for intended reuse.
  - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  - 3. Protect items from damage during transport and storage.
  - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

## 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."
- F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 07 5419 Polyvinyl-Chloride (PVC) Roofing or 07 5423 Thermoplastic Polyolefin (TPO) Roofing for new roofing requirements.
  - 1. Remove existing roof membrane, flashings, copings, and roof accessories.
  - 2. Remove existing roofing system down to substrate.

## 3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site 021
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  - 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

#### 3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

## SECTION 033000 - CAST-IN-PLACE CONCRETE

## PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings.
  - 2. Foundation walls.
  - 3. Slabs-on-grade.

#### 1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Field quality-control test and inspection reports.
- E. Minutes of preinstallation conference.
- F. Color samples of lamp black.

## 1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

- B. Installer Qualifications for Penetrating Liquid Floor Treatment: A qualified installer approved in writing by the liquid floor treatment manufacturer.
- C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- D. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301, "Specification for Structural Concrete,"
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." The General Contractor shall be responsible for coordinating and scheduling testing and curing times, as well as protection from the weather, in order to accommodate flooring finishes, including slabs to receive moisture sensitive flooring.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

## PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

- 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
- 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

## 2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.

## 2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

# 2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel

wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

# 2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class C.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33 coarse aggregate or better, graded. Provide aggregates from a single source.
  - 1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M and potable.

## 2.6 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures, color stable nonfading, and resistant to lime and other alkalis all exposed building concrete.
  - 1. Available Manufacturers:
    - a. Bayer Corporation
    - b. ChemMasters
    - c. Conspec Marketing and Manufacturing Co., Inc., a Dayton Superior Company
    - d. Davis Colors
    - e. Elementis Pigments, Inc.
    - f. Hoover Color Corporation
    - g. Lambert Corporation
    - h. Scofield, L.M. Company
    - i. Solomon Colors
  - 2. Color: Color to match Davis colors :"light grey"; made from 2.5 lbs. of color number 860 per 94 lb. sack of cement.

- C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
- D. Sealers: Provide premium-quality, waterborne, one-component, clear, acrylic-polyurethane sealer resistant to staining, abrasion and ultraviolet (UV) radiation designed to protect concrete hardscapes, floors, cementitious toppings, and vertical concrete. To be used over color stained concrete areas as noted on the drawings and exterior concrete areas above conditioned spaces below. Basis of Design is Scofield Selectseal-W.

## 2.7 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
  - 1. Available Manufacturers:
    - a. Greenstreak.
    - b. Meadows, W. R., Inc.

## 2.8 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape. Not less than 10 mils thick.
  - 1. Available Products:
    - a. Fortifiber Corporation; Moistop Ultra A.
    - b. Raven Industries Inc.; Vapor Block.
    - c. Reef Industries, Inc.; Griffolyn Type.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

# 2.9 FLOOR AND SLAB TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces. Use only for slabs specified to be exposed, sealed concrete.

- 1. Manufacturers: Penetrating Liquid Floor Treatment products manufactured or supplied by the following manufacturer are the basis of design products: Subject to compliance with requirements, provide the following product:
  - a. Euclid Chemical Company (The); Euco Diamond Hard VOX."
- 2. Alternate Manufacturers: Use of Penetrating Liquid Floor Treatment products other than the Basis of Design products may be used upon approval of pre-bid substitution request. Approval criteria include, but are not limited to, aesthetic acceptability as determined by the Architect, and whether use of a product other than the basis of design product will result in revisions to other components of the Work. Alternate manufacturers offering products which may be incorporated into the Work include, but are not limited to the following:
  - a. Curecrete Distribution Inc.; Ashford Formula.
  - b. Dayton Superior Corporation; Day-Chem Sure Hard.
- B. Penetrating Epoxy Sealer: Clear, two component epoxy system designed to penetrate concrete surfaces, improve wear resistance and lower absorption of water and salts; provide with silica sand for slip resistance. Use only for exterior slabs, landings and stairs.
  - 1. Manufacturers: Penetrating Epoxy Sealer products manufactured or supplied by the following manufacturer are the basis of design products: Subject to compliance with requirements, provide the following product:
    - a. Euclid Chemical Company (The); Euco #512 VOX Epoxy Sealer."
  - 2. Alternate Manufacturers: Use of Penetrating Epoxy Sealer products other than the Basis of Design products may be used upon approval of pre-bid substitution request. Approval criteria include, but are not limited to, aesthetic acceptability as determined by the Architect, and whether use of a product other than the basis of design product will result in revisions to other components of the Work.

# 2.10 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

## 2.11 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240. Apply only at exposed concrete slabs.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows: Use only where noted in drawings and details.
  - 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- E. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

#### 2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash: Ref general structural notes.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

## 2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Proportion all concrete mixtures as noted on general structural notes: Sheets on structural drawings.

#### 2.14 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.15 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes.

## PART 3 - EXECUTION

## 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
  - 2. Class C, 1/2 inch (13 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, reglets, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.

- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

## 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

# 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

## 3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.

## 3.5 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
  - 2. Seal all penetrations including pipes with manufacturers standard pipe boot and tape.

## 3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

## 3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. Space vertical joints in walls at 30'-0" maximum. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
  - 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
  - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

## 3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

## 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, sound insulation and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

- 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Maintain reinforcement in position on chairs during concrete placement.
  - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 4. Slope surfaces uniformly to drains where required.
  - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
  - 1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

# 3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces not exposed to public view.

- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces exposed to public view,
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

#### 3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in 1 direction.
  - 1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces indicated to receive trowel finish.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings. Final finish: steel trowel by hand for burnished finish effect for slabs exposed to view in the finish Work.
  - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  - 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
    - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

- 1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

## 3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

#### 3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing. Coordinate with the requirements of liquid floor treatment manufacturer for application and removal of curing compounds at slabs with exposed concrete finishes.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Moist cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces using methods described in Part 2 Article "Curing Materials" in accordance with ACI 308.1.

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# 3.14 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions as slab noted to be exposed, sealed concrete.
  - 1. Remove sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  - 2. Do not apply to concrete that is less than 28 days' old.
  - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
  - 4. Provide at all interior concrete exposed without other finish, refer to Room finish Schedule in the Drawings.
  - 5. Protect floors from stains and other damage prior to and after treatment. Immediately prior Substantial Completion, clean and polish (buff) treated floors.
- B. Penetrating Epoxy Sealer: Prepare and apply penetrating epoxy sealer according to manufacturer's written instructions at exterior platform slabs, stairs and landings.
  - 1. Remove sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  - 2. Do not apply to concrete that is less than 28 days' old.
  - 3. Mix components in field in accordance with manufacturer's instructions. Epoxy must be well mixed to ensure proper chemical reaction. Place immediately after mixing. Broadcast silica sand in accordance with the manufacturer's recommendations for slip resistance.
  - 4. Provide at exterior platform slabs, stairs and landings

## 3.15 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
  - 1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

## 3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  - 2. After concrete has cured at least 14 days, correct high areas by grinding.
  - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  - 6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  - 7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place

patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

## 3.17 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections: As noted in general structural notes of structural drawings.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
  - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
  - 5. Compression Test Specimens: ASTM C 31/C 31M.
    - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
  - 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  - 7. When strength of field-cured cylinders is less than 85 percent of companion laboratorycured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

- 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
- 9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- 10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- 11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
- 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 13. Correct deficiencies in the Work that test reports and inspections indicate dos not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

END OF SECTION 033000

## SECTION 033543 - BONDED ABRASIVE POLISHED CONCRETE FLOORS

## 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: Products and procedures for bonded abrasive polishing concrete floors using multi-step wet/dry mechanical process, and accessories indicated, specified, or required to complete polishing.

## 1.3 DEFINITIONS

- A. CPPA: Concrete Polishing Association of America.
- B. Terminology: As defined by CPAA.
- C. Polished Concrete: The act of changing a concrete floor surface, with or without aggregate exposure, to achieve a specified level of gloss.
- D. Bonded Abrasive Polished Concrete: The multi-step operation of mechanically grinding, honing, polishing of a concrete floor surface with bonded abrasives to cut a concrete floor surface and to refine each cut to the maximum potential to achieve a specified level of finished gloss as defined by the CPAA.

### 1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer's technical literature for each product indicated, specified, or required. Include manufacturer's technical data, application instructions, and recommendations.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Installer Qualifications: Data for company, principal personnel, experience, and training specified in PART 1 "Quality Assurance" Article.
- B. Field Quality Control Dynamic Coefficient of Friction Test Reports: Reports of testing specified in PART 3 "Field Quality Control" Article.
- C. Field Quality Control Static Coefficient of friction test reports: report of testing specified in Part 3 "Field Quality Control" article.

- D. Maintenance Data: For inclusion in maintenance manual required by Division 01.
  - 1. Include instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use.
  - 2. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

## 1.6 QUALITY ASSURANCE

- A. Polisher Qualifications:
  - 1. Experience: Company experienced in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce specified work.
  - 2. Supervision: Maintain competent supervisor who is at Project during times specified work is in progress, and is currently certified as Craftsman Level I or higher by CPAA.
  - 3. Manufacturer Qualification: Approved by manufacturer to apply liquid applied products.
- B. Walkway Auditor: Certified by CPAA or NFSI to test bonded abrasive polished concrete floors for dynamic and static coefficient of friction according to ANSI B101.1 and B101.3.
- C. Coefficient of Friction: Achieve following coefficient of friction by field quality control testing in accordance to the following standards:
  - 1. ANSI B101.1 Static Coefficient of Friction Achieve a minimum of .42 for level floor surfaces.
  - 2. ANSI B101.3 Dynamic Coefficient of Friction Achieve a minimum of .35 for level floor surfaces.
- D. Field Mock-up: Before performing work of this Section, provide following field mock-up to verify selections made under submittals and to demonstrate aesthetic effects of polishing. Approval does not constitute approval of deviations from Contract Documents, unless Architect specifically approves deviations in writing.
  - 1. Form, reinforce, and cast concrete slab for 10 foot square field mock-up.
  - 2. Concrete shall be same mix design as scheduled for Project.
  - 3. Placement and finishing work shall be performed by same personnel as will place and finish concrete for Project.
  - 4. Mock-up shall be representative of work to be expected
  - 5. Perform grinding, honing, and polishing work as scheduled for Project using same personnel as will perform work for Project.
  - 6. Approval is for following aesthetic qualities:
    - a. Compliance with approved submittals.
    - b. Compliance with specified aggregate exposure.
    - c. Compliance with specified finished gloss level.
  - 7. Obtain Architect's approval before starting work on Project.

- 8. Protect and maintain approved field mock-ups during construction in an undisturbed condition as a standard for judging completed work.
- E. Pre-Installation of Concrete Conference: Prior to placing concrete for areas scheduled for polishing, conduct conference at Project to comply with requirements of applicable Division 01 Sections.
  - 1. Required Attendees:
    - a. Owner.
    - b. Architect.
    - c. Contractor, including supervisor.
    - d. Concrete finisher, including supervisor.
    - e. Concrete polisher, including supervisor.
    - f. Technical representative of liquid applied product manufacturers.
    - g. Walkway auditor.
  - 2. Minimum Agenda: Polisher shall demonstrate understanding of work required by reviewing and discussing procedures for, but not limited to, following:
    - a. Tour field mock-up and representative areas of required work, discuss and evaluate for compliance with Contract Documents, including substrate conditions, surface preparations, sequence of procedures, and other preparatory work performed by other installers.
    - b. Review Contract Document requirements.
    - c. Review approved submittals and field mock-up.
    - d. Review procedures, including applicable Division 03 Section on cast-in-place concrete and as follows:
      - 1) Protection of concrete substrate during construction and prior to polishing process.
      - 2) Project phasing and scheduling for each step of grinding, honing and polishing operations including, but not limited to:
        - a) Quality of qualified personnel committed to project.
        - b) Quality and size of grinders committed to project.
        - c) Proper disposal of concrete slurry and/or concrete dust.
      - 3) Details of each step of grinding, honing, and polishing operations.
        - a) Application of liquid applied products.
        - b) Protecting polished concrete floors after polishing work is complete.

#### 1.7 PROJECT CONDITIONS

- A. Damage and Stain Prevention: Take precautions to prevent damage and staining of concrete surfaces to be polished.
  - 1. Prohibit use of markers, spray paint, and soapstone.

- 2. Prohibit improper application of liquid membrane film forming curing compounds.
- 3. Prohibit vehicle parking over concrete surfaces.
- 4. Prohibit pipe-cutting operations over concrete surfaces.
- 5. Prohibit ferrous metals storage over concrete surfaces.
- 6. Protect from petroleum, oil, hydraulic fluid, or other liquid dripping from equipment working over concrete surfaces.
- 7. Protect from acids and acidic detergents contacting concrete surfaces.
- 8. Protect from painting activities over concrete surfaces.
- B. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting liquid applied product application.

## PART 2 - PRODUCTS

## 2.1 LIQUID APPLIED PRODUCTS

- A. Liquid Densifier: An Aqueous solution of Silicon Dioxide dissolved in one of the following Hydroxides that penetrates into the concrete surface and reacts with the Calcium Hydroxide to provide a permanent chemical reaction that hardens and densifies the wear surface of the cementitious portion of the concrete.
  - 1. Sodium Silicate
  - 2. Potassium Silicate
  - 3. Lithium Silicate
  - 4. Alkalis solution of Colloidal Silicates or Silica
- B. Sealer Impregnating Stain Protection: Non film forming stain and food resistant penetrating sealer designed to be applied to densified and polished concrete which meets the requirements of OSHA for slip resistance as tested by ASTM D 2047 and stain resistance of ASTM D 1308.

#### 2.2 ACCESSORIES

- A. Repair Material: A product that is designed to repair cracks and surface imperfections. The specified material must have sufficient bonding capabilities to adhere after the polishing to the concrete surface and provide abrasion resistance equal to or greater than the surrounding concrete substrate.
- B. Grout Material: A thin mortar used for filling spaces. Acceptable products shall be:
  - 1. Epoxy, urethane, poluyrea, or polyaspartic resins.
  - 2. Latex or acrylic binders mixed with cement dust from previous grinding steps.
  - 3. Silicate binders mixed with cement dust from previous grinding steps.
- C. Protective Cover: Non-woven, puncture and tear resistant, polypropylene fibers laminated with a multi-ply, textured membrane, not less than 18 mils in thickness.

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## 2.3 POLISHING EQUIPMENT

- A. Field Grinding and Polishing Equipment:
  - 1. A multiple head, counter rotating, walk behind or ride on machine, of various size and weights, with diamond tooling affixed to the head for the purpose of grinding concrete. Excludes janitorial maintenance equipment.
  - 2. If dry grinding, honing, or polishing, use dust extraction equipment with flow rate suitable for dust generated, with squeegee attachments.
  - 3. If wet grinding, honing, or polishing, use slurry extraction equipment suitable for slurry removal and containment prior to proper disposal.
- B. Edge Grinding and Polishing Equipment: Hand-held or walk-behind machines which produces same results, without noticeable differences, as field grinding and polishing equipment.
- C. Burnishing Equipment: High speed walk-behind or ride-on machines capable of generating 1000 to 2000 revolutions per minute and with sufficient head pressure of not less than 20 pounds to raise floor temperature by 20 degrees F.
- D. Diamond Tooling: Abrasive tools that contain industrial grade diamonds within a bonded matrix (such as metallic, resinous, ceramic, etc) that are attached to rotating heads to refine the concrete substrate.
  - 1. Bonded Abrasive: Abrasive medium that is held within a bonding that erodes away to expose new abrasive medium as it is used.
  - 2. Metal Bond Tooling: Diamond tooling that contains industrial grade diamonds with a metallic bonded matrix that is attached to rotating heads to refine the concrete substrate. These tools are available in levels of soft, medium, and hard metallic matrices that are matched with contrasting concrete substrates (i.e. hard matrix/soft concrete, medium matrix/medium concrete, soft matrix/hard concrete) and are typically used in the grinding and early honing stages of the polishing process.
  - 3. Resin Bond Tooling: Diamond tooling that contains industrial grade diamonds within a resinous bonded matrix (poly-phenolic, ester-phenolic, thermoplastic-phenolic) that is attached to rotating heads to refine the concrete substrate. Resin bond tooling does not have the soft/medium/hard characteristics of metal bond tooling and are typically used for the later honing and polishing stages of the polishing process.
  - 4. Hybrid Tooling: Diamond tooling that combines metal bond and resin bond that has the characteristics of both types of tooling. These types of tools are typically used as either transitional tooling from metal bond tools to resin bond tools or as a first cut tool on smooth concrete surfaces.
  - 5. Transitional Tooling: Diamond tooling that is used to refine the scratch pattern of metal bond tooling prior to the application of resin bond tooling in an effort to extend the life of resin bond tooling and to create a better foundation for the polishing process.
  - 6. Abrasive Pad: An abrasive pad, resembling a typical floor maintenance burnishing pad, that has the capability of refining the concrete surface on a microscopic level that may or may not contain industrial grade diamonds. These pads are typically used for the maintenance and/or restoration of previously installed polished concrete flooring.

## PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of concrete floor topping including:
  - 1. Concrete Finished Floor Flatness according to applicable Division 03 Section on cast-inplace concrete.
- B. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
- C. Starting work within a particular area will be construed as acceptance of surface conditions.

## 3.2 PREPARATION

- A. Cleaning Concrete Surfaces:
  - 1. Prepare and clean concrete surfaces.
  - 2. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, paint splatter, and other contaminants incompatible with liquid applied products and polishing.

## 3.3 POLISHING CONCRETE FLOORS

- A. Perform all polishing procedures to ensure a consistent appearance from wall to wall.
- B. Initial Grinding:
  - 1. Use grinding equipment with metal or semi-metal bonded tooling.
  - 2. Begin grinding in one direction using sufficient size equipment and diamond tooling to meet specified aggregate exposure class.
  - 3. Make sequential passes with each pass perpendicular to previous pass using finer grit tool with each pass, up to 100 grit metal bonded tooling.
  - 4. Achieve maximum refinement with each pass before proceeding to finer grit tools.
  - 5. Clean floor thoroughly after each pass using dust extraction equipment properly fitted with squeegee attachment or walk behind auto scrubber suitable to remove all visible loose debris and dust.
  - 6. Continue grinding until aggregate exposure matches approved field mock-ups.
- C. Treating Surface Imperfections:
  - 1. Mix patching compound or grout material with dust created by grinding operations, manufacturer's tint, or sand to match color of adjacent concrete surfaces.

- 2. Fill surface imperfections including, but not limited to, holes, surface damage, small and micro cracks, air holes, pop-outs, and voids with grout to eliminate micro pitting in finished work.
- 3. Work compound and treatment until color differences between concrete surface and filled surface imperfections are not reasonably noticeable when viewed from 10 feet away under lighting conditions that will be present after construction.
- D. Liquid Densifier Application: Apply undiluted to point of rejection, remove excess liquid, and allow curing according to manufacturers instructions.
- E. Grout Grinding:
  - 1. Use grinding equipment and appropriate grit and bond diamond tooling.
  - 2. Apply grout, forced into the pore structure of the concrete substrate, to fill surface imperfections.
  - 3. Clean floor thoroughly after each pass using dust extraction equipment properly fitted with squeegee attachment or walk behind auto scrubber suitable to remove all visible loose debris and dust.
- F. Honing:
  - 1. Use grinding equipment with hybrid or resin bonded tooling.
  - 2. Hone concrete in one direction starting with a 100 grit tooling and make as many sequential passes as required to remove scratches, each pass perpendicular to previous pass, up to 800 grit tooling reaching maximum refinement with each pass before proceeding to finer grit tooling.
  - 3. Clean floor thoroughly after each pass using dust extraction equipment properly fitted with squeegee attachment or walk behind auto scrubber suitable to remove all visible loose debris and dust.
- G. Final Polished Concrete Floor Finish:
  - 1. Aggregate Exposure Class B Fine / Sand Aggregate Finish: Remove not more than 1/16 inch of concrete surface by grinding and polishing resulting in majority of exposure displaying fine aggregate with no, or small amount of, medium aggregate at random locations.
  - 2. Finished Gloss Level 2 Medium Gloss Appearance:
    - a. Procedure: Recommended not less than 4 step process with full refinement of each diamond tool with one application of densifier.
    - b. Gloss Measurement: Determine the specular gloss by incorporating the following:
      - 1) Reflective Clarity Reading: Not less than 55 according to ASTM D5767 prior to the application of sealers.
      - 2) Reflective Sheen Reading: Not less than 25 according to ASTM D523 prior to the application of sealers.
- H. Extent of Finish: Finish shall extend to within  $\frac{1}{2}$  inch of all vertical surfaces.

# 3.4 FIELD QUALITY CONTROL

- A. Field Testing: Engage a qualified walkway auditor to perform field testing to determine if polished concrete floor finish complies with specified coefficient of friction;
  - 1. ANSI B101.1 for static coefficient of friction.
  - 2. ANSI B101.3 for dynamic coefficient of friction.

# 3.5 **PROTECTION**

A. Covering: After completion of polishing, protect polished floors from subsequent construction activities with protective covering.

END OF SECTION 033543

# SECTION 042113 - BRICK MASONRY

#### PART 1 - GENERAL

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

#### 1.2 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
  - 1. Face brick.
  - 2. Mortar and grout.
  - 3. Masonry joint reinforcement.
  - 4. Ties and anchors.
  - 5. Miscellaneous masonry accessories.
- B. Related Sections include the following:
  - 1. Division 7 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing in masonry.

#### 1.3 SUBMITTALS

- A. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
- B. Samples for verification: For the following:
  - 1. Colored mortar.
  - 2. Face brick, in the form of straps of five or more bricks.
  - 3. Weep holes/vents.
  - 4. Accessories embedded in masonry.
- C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
- D. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

## 1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of typical brick veneer area as shown on Drawings.
    - a. Include a sealant-filled expansion joint at least 16 inches (400 mm) long in mockup.
    - b. Include lower corner of window opening in mockup.
    - c. Include studs, sheathing, veneer anchors, flashing, and weep holes in mockup.
  - 2. Erect mockups adjacent and parallel to existing surface.
  - 3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
  - 4. Protect accepted mockups from the elements with weather-resistant membrane.
  - 5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    - a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
  - 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store pre-blended, dry mortar mix in delivery containers on

elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.6 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
  - 2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## PART 2 - PRODUCTS

# 2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified below.

# 2.2 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

### 2.3 BRICK

- A. General: Provide shapes indicated and as follows:
  - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  - 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: ASTM C 216, Grade SW, Type FBX.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi (20.7 MPa).
  - 2. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
  - 3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
  - 4. Size (Actual Dimensions): Employ standard or custom production set-up to achieve the following actual dimensions:
    - a. 3-1/2 inches wide by 2-1/2 inches high by 11-1/2 inches.
  - 5. Color and Texture: Columbia Red, Mission Texture by Mutual Materials.
  - 6. Basis of Design Products:
    - a. Mutual Materials, Face Brick

### 2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Mortar Cement: ASTM C 1329.
  - 1. Available Products:
    - a. Lafarge North America Inc.; Lafarge Mortar Cement.
- C. Aggregate for Mortar: ASTM C 144.
  - 1. For joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
- D. Aggregate for Grout: ASTM C 404.
- E. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.
- F. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, mediumduty refractory mortar that passes ASTM C 199 test; or an equivalent product acceptable to authorities having jurisdiction.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
  - 1. Available Products:
    - a. Addiment Incorporated; Mortar Kick.
    - b. Euclid Chemical Company (The); Accelguard 80.
    - c. Grace Construction Products, a unit of W. R. Grace & Co. Conn.; Morset.
    - d. Sonneborn, Div. of ChemRex; Trimix-NCA.
- H. Water: Potable.

#### 2.5 REINFORCEMENT

- A. Masonry Joint Reinforcement, General: ASTM A 951.
  - 1. Exterior Walls: Hot-dip galvanized, carbon or Stainless steel.
  - 2. Wire Size for Side Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
  - 3. Wire Size for Cross Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
  - 4. Wire Size for Veneer Ties: W1.7 or 0.148-inch (3.8-mm) diameter.

- 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
- 6. Provide in lengths of not less than 10 feet (3 m).
- B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized, carbon or stainless-steel continuous wire.

### 2.6 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with five subparagraphs below, unless otherwise indicated.
  - 1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 641/A 641M, Class 1 coating.
  - 2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
  - 3. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.
  - 4. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
  - 5. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Adjustable Masonry-Veneer Anchors:
  - 1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
    - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).
  - 2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - Dayton Superior Corporation, Dur-O-Wal Division; D/A 210 with D/A 700-708.
      - 2) Heckmann Building Products Inc.; 315-D with 316.
      - 3) Hohmann & Barnard, Inc.; DW-10HS.
      - 4) Wire-Bond; 1004, Type III.
    - b. Anchor Section: Sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch (16 mm) wide by 3-5/8 inches (92 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie.

### 2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- C. Weep/Vent Products: Use one of the following, unless otherwise indicated:
  - 1. Wicking Material: Absorbent rope, made from cotton, 1/4 to 3/8 inch (6 to 10 mm) in diameter, in length required to produce 2-inch (50-mm) exposure on exterior and 18 inches (450 mm) in cavity between wythes. Use only for weeps.
  - 2. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches (9 by 38 by 89 mm) long.
- D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 1. Provide one of the following configurations:
    - a. Strips, full-depth of cavity and 10 inches (250 mm) wide, with dovetail shaped notches 7 inches (175 mm) deep that prevent mesh from being clogged with mortar droppings.
    - b. Sheets or strips not less than 1 inch (25 mm) thick and installed to full height of cavity with additional strips 4 inches (100 mm) high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from being clogged with mortar.

#### 2.8 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
  - 1. Available Manufacturers:
    - a. Diedrich Technologies, Inc.
    - b. EaCo Chem, Inc.
    - c. ProSoCo, Inc.

# 2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

- 1. Do not use calcium chloride in mortar or grout.
- 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
- 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270. Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
  - 1. Use Type S mortar throughout.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
  - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530/ASCE 5/TMS 402 for dimensions of grout spaces and pour height.
  - 2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.
- E. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

#### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
  - 2. Verify that foundations are within tolerances specified.
  - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

# 3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
  - 1. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
  - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
  - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
  - 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
  - 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
  - 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
  - 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.
  - 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

#### 3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in one third running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

# 3.4 MORTAR BEDDING AND JOINTING

- A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. All joints to be 1/2" in width.
- C. For exposed joints tool vertical and horizontal joints concave 1/8" (4 mm) deep, smooth.

# 3.5 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
  - 1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
  - 2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
  - 3. Embed tie sections in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
  - 4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  - 5. Space anchors as indicated, but not more than 18 inches (458 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.

### 3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
  - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
  - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.
    - a. Reinforcement above is in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

# 3.7 COMPOSITE MASONRY

- A. Bond wythes of brick masonry to CMU together using the following method:
  - 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. (0.42 sq. m) of wall area spaced not to exceed 16 inches (406 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of edges and space not more than 36 inches (914 mm) apart around perimeter of walls. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
    - a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.

# 3.8 WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. Install weep holes as follows:
  - 1. Use specified weep/vent products or open head joints to form weep holes.
  - 2. Space weep holes 24 inches (600 mm) o.c., unless otherwise indicated.
- B. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

### 3.9 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and no-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

### 3.10 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soilcontaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
  - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section "Earth Moving."
  - 3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

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END OF SECTION 042113

# SECTION 051200 - STRUCTURAL STEEL FRAMING

# PART 1 - GENERAL

### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Structural steel.
  - 2. Grout.
- B. Related Sections include the following:
  - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
  - 2. Division 05 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other metal items not defined as structural steel.

#### 1.2 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

# 1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication of structural-steel components.
  - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  - 2. Include embedment drawings.
  - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
  - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
- B. Welding certificates. Only when requested.

### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program.
- B. Fabricator Qualifications: A qualified fabricator shall be an "Approved Fabricator" in accordance with IBC Section 1704.2, registered and approved by the local building department.

In lieu of the previous, fabricators shall include in their bid the services of a special inspector to provide inspection/testing services for in-shop work to meet the requirements of IBC Section 1704.

- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- D. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
  - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

#### 1.6 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

# PART 2 - PRODUCTS

# 2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
- B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Corrosion-Resisting Structural Steel: ASTM A 588/A 588M, Grade 50 (345).
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

- F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- G. Medium-Strength Steel Castings: ASTM A 27/A 27M, Grade 65-35 (Grade 450-240), carbon steel.
- H. High-Strength Steel Castings: ASTM A 148/A 148M,Grade 80-50 (Grade 550-345), carbon or alloy steel.
- I. Welding Electrodes: Comply with AWS requirements.

### 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
  - 1. Finish: Plain.
- B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- C. Headed Anchor Rods: ASTM F 1554, Grade 36, weldable, straight.
  - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy hex carbon steel.
  - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
  - 3. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
  - 4. Finish: Plain.
- D. Threaded Rods: ASTM A 36/A 36M.
  - 1. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
  - 2. Washers: ASTM A 36/A 36M carbon steel.
  - 3. Finish: Plain.

### 2.3 PRIMER

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat specified in Division 09 painting Sections.

# 2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

# 2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design Load and Resistance Factor Design Specification for Structural Steel Buildings."
  - 1. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
  - 2. Mark and match-mark materials for field assembly.
  - 3. Complete structural-steel assemblies, including welding of units, before starting shoppriming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
  - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

#### 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
  - 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
  - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

### 2.7 SHOP PRIMING

- A. Shop prime steel surfaces. Only indicated to be exposed, painted.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 2, "Hand Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

### 2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
  - 1. Fill vent holes and grind smooth after galvanizing.
  - 2. Galvanize shelf angles attached to structural-steel frame and located in exterior walls.

# PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

# 3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."

- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
  - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of base plate.
  - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
  - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure.
  - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

# 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

- 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
- 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
- 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

# 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
  - 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
    - d. Radiographic Inspection: ASTM E 94.
- C. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
  - 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
  - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

#### 3.6 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.

- 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 051200

SECTION 055000 - METAL FABRICATIONS

# PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Steel framing and supports for countertops.
  - 2. Steel framing and supports for mechanical and electrical equipment.
  - 3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - 4. Steel pipe columns for supporting wood frame construction.
  - 5. Shelf angles.
  - 6. Metal ladders.
  - 7. Ladder Safety Cages
- B. Products furnished, but not installed, under this Section include the following:
  - 1. Loose steel lintels.
  - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
  - 3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
- C. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
  - 2. Section 051200 "Structural Steel Framing."

# 1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves,

concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## 1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
  - 1. Steel framing and supports for countertops.
  - 2. Steel framing and supports for mechanical and electrical equipment.
  - 3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - 4. Steel pipe columns for supporting wood frame construction.
  - 5. Shelf angles.
  - 6. Metal ladders.
  - 7. Ladder Safety Cages.

### 1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

#### 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum."
  - 3. AWS D1.6/D1.6M, "Structural Welding Code Stainless Steel."

#### 1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

#### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladder and ladder safety cage.
- B. Structural Performance of Ladder: Ladder shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

- 1. Uniform Load: 100 lbf/sq. ft.
- 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in...
- 3. Uniform and concentrated loads need not be assumed to act concurrently.
- 4. Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

# 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: As indicated on Structural General Notes.
- C. Steel Tubing: As indicated on Structural General Notes.
- D. Steel Pipe: As indicated on Structural General Notes.
- E. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- F. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

# 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless-steel fasteners for fastening aluminum.
  - 2. Provide stainless-steel fasteners for fastening stainless steel.
  - 3. Provide stainless-steel fasteners for fastening nickel silver.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
  - 1. Finish: Plain.

- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1).
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- G. Post-Installed Anchors: As indicated on structural drawings.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

# 2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 Interior Painting."
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normalweight, air-entrained, concrete with a minimum 28-day compressive strength as indicated in general structural notes.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

# 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
  - 1. Fabricate units from slotted channel framing where indicated.
  - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports at exterior locations.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

# 2.7 METAL LADDERS

- A. General:
  - 1. Comply with ANSI A14.3
- B. Steel Ladders:
  - 1. Space sider-ails 16 inches apart unless otherwise indicated.
  - 2. Side-rails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
  - 3. Rungs: 3/4-inch- steel bars.
  - 4. Fit rungs in centerline of side-rails; plug-weld and grind smooth on outer rail faces.
  - 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminumoxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
  - 6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
  - 7. Prime ladders, including brackets and fasteners, with zinc-rich primer

# 2.8 LADDER SAFETY CAGES

- A. General:
  - 1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
  - 2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet (6 m) o.c. Provide secondary intermediate hoops spaced not more than 48 inches (1200 mm) o.c. between primary hoops.
  - 3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners unless otherwise indicated.
- B. Steel Ladder Safety Cages:
  - 1. Primary Hoops: 1/4-by-4-inch (6.4-by-100-mm) flat bar hoops.
  - 2. Secondary Intermediate Hoops: 1/4-by-2-inch (6.4-by-50-mm) flat bar hoops.
  - 3. Vertical Bars: 3/16-by-1-1/2-inch (4.8-by-38-mm) flat bars secured to each hoop.
  - 4. Galvanize and prime ladder safety cages, including brackets and fasteners.

2.9 Prime ladder safety cages, including brackets and fasteners, with zinc-rich primer.

### 2.10 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
  - 1. Provide mitered and welded units at corners.
  - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize and prime shelf angles located in exterior walls.
- D. Prime shelf angles located in exterior walls with zinc-rich primer.
- E. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.
- 2.11 FINISHES, GENERAL
  - A. Finish metal fabrications after assembly.
  - B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

### 2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with universal shop primer indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool

- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

### 2.13 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

### 3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

## 3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Framing with dimension lumber.
  - 2. Framing with timber.
  - 3. Shear wall panels.
  - 4. Wood Preservative Treated Lumber
  - 5. Rooftop equipment bases and support curbs.
  - 6. Wood blocking, cants, and nailers and outriggers.
  - 7. Wood furring.
  - 8. Wood sleepers.
  - 9. Plywood backing panels.
- B. Related Requirements:
  - 1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

#### 1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal (114 mm actual) size or greater in least dimension.

# 1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

### ROUGH CARPENTRY

- B. Evaluation Reports: For the following, from ICC-ES:
  - 1. Fire-retardant-treated wood.
  - 2. Engineered wood products.
  - 3. Shear panels.
  - 4. Metal framing anchors.

### 1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fireretardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

#### PART 2 - PRODUCTS

#### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
  - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: as indicated on structural general notes.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
  - 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

### 2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
  - 1. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
  - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat items indicated on Drawings, and the following:
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
  - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
  - 4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
  - 5. Wood floor plates that are installed over concrete slabs-on-grade.

# 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  - 1. Treatment shall not promote corrosion of metal fasteners.
  - 2. Exterior Type: Treated materials shall comply with requirements specified above for fireretardant-treated lumber and plywood by pressure process after being subjected to

accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

- 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
  - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat items indicated on Drawings:
- 2.4 DIMENSION LUMBER FRAMING
  - A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.
    - 1. Application: Interior partitions not indicated as load bearing.
    - 2. Species:
      - a. Douglas Fir-Larch; WCLIB or WWPA.
  - B. Load-Bearing Partitions: Grade as indicated on structural general notes.
    - 1. Application: Exterior walls and interior load-bearing partitions.
    - 2. Species: as indicated on structural general notes.
  - C. Joists, Rafters, and Other Framing Not Listed Above: Grade as indicated on structural general notes.
    - 1. Species: as indicated on structural general notes.
  - D. Exposed Framing Indicated to Receive a Stained or Natural Finish: Hand-select material for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
    - 1. Species and Grade: As indicated above for load-bearing construction of same type.

### 2.5 TIMBER FRAMING

- A. Comply with the following requirements, according to grading rules of grading agency indicated:
  - 1. Species and Grade: as indicated on structural general notes.

### 2.6 ENGINEERED WOOD PRODUCTS

- A. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Weyerhaeuser Company.
    - b. RedBuilt LLC
  - 2. Structural Properties: Depths and design values not less than those indicated on drawings.
- B. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research or evaluation report for I-joists.
  - 1. Manufacturer: Provide products by same manufacturer as I-joists.

### 2.7 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Rooftop equipment bases and support curbs.
  - 4. Cants.
  - 5. Furring.
  - 6. Grounds.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of the following species:
  - 1. Douglas fir-larch.
- C. Concealed Boards: 15 percent maximum moisture content and any of the species and grades indicated in the general structural notes.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

### 2.8 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

## 2.9 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
  - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- G. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC58 ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
- H. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

#### 2.10 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Simpson Strong-Tie Co., Inc.
- B. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified

independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
  - 1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), highstrength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
  - 1. Use for wood-preservative-treated lumber and where indicated.
- E. Stainless-Steel Sheet: ASTM A 666, Type 304.
  - 1. Use for exterior locations and where indicated.
- F. Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges at least 85 percent of joist depth.
  - 1. Thickness: as indicated on drawings.
- G. I-Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.
  - 1. Thickness: as indicated on drawings.
- H. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
  - 1. Strap Width: as indicated on drawings.
  - 2. Thickness: as indicated on drawings.
- I. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch (25 mm) above base and with 2-inch- (50-mm-) minimum side cover, socket 0.062 inch (1.6 mm) thick, and standoff and adjustment plates 0.108 inch (2.8 mm) thick.
- J. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
  - 1. Width: as indicated on drawings.
  - 2. Thickness: as indicated on drawings.
  - 3. Length: as indicated on drawings.
- K. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.

- 1. Bolt Diameter: as indicated on drawings.
- 2. Width: as indicated on drawings.
- 3. Body Thickness: as indicated on drawings.
- 4. Base Reinforcement Thickness: as indicated on drawings.

## 2.11 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

# PART 3 - EXECUTION

- 3.1 INSTALLATION, GENERAL
  - A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
  - B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
  - C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
  - D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
  - E. Install shear wall panels to comply with manufacturer's written instructions.
  - F. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
  - G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
  - H. Do not splice structural members between supports unless otherwise indicated.
  - I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
    - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
  - J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

- 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
- 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.
- 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
- 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.
- K. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- L. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.
- M. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- N. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
  - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
  - 3. ICC-ES evaluation report for fastener.
- O. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- P. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
  - 1. Comply with indicated fastener patterns where applicable.
  - 2. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.
### 3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

### 3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring horizontally and vertically at 24 inches (610 mm) o.c.

### 3.4 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.
  - 1. For exterior walls, provide 2-by-10-inch nominal- (38-by-235mm actual-), 2-by-8-inch nominal,- (38-by-184mm actual-), 2-by-6-inch nominal- (38-by-140-mm actual-), 2-by-4-inch nominal- (38-by-89-mm actual-) size wood studs spaced 24 inches (610 mm) o.c. unless otherwise indicated.
  - 2. For interior partitions and walls, provide 2-by-6-inch nominal- (38-by-140-mm actual-) size wood studs spaced 16 inches (406 mm) o.c. unless otherwise indicated.
  - 3. Provide continuous horizontal blocking at midheight of partitions more than 96 inches (2438 mm) high, using members of 2-inch nominal (38-mm actual) thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
  - 1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4inch nominal (89-mm actual) depth for openings 48 inches (1200 mm) and less in width, 6-inch nominal (140-mm actual) depth for openings 48 to 72 inches (1200 to 1800 mm) in width, 8-inch nominal (184-mm actual) depth for openings 72 to 120 inches (1800 to 3000 mm) in width, and not less than 10-inch nominal (235-mm actual) depth for openings 10 to 12 feet (3 to 3.6 m) in width.

2. For load-bearing walls, provide double-jamb studs for openings 60 inches (1500 mm) and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

## 3.5 CEILING JOIST AND RAFTER FRAMING INSTALLATION

- A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
  - 1. Sizes: as indicated on drawings.
- B. Rafters: Notch to fit exterior wall plates and[ toe nail or] use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
  - 1. Sizes: as indicated on drawings.

## 3.6 TIMBER FRAMING INSTALLATION

- A. Install timber beams with crown edge up and provide not less than 4 inches (102 mm) of bearing on supports. Provide continuous members unless otherwise indicated; tie together over supports as indicated if not continuous.
- B. Where beams or girders are framed into pockets of exterior concrete or masonry walls, provide 1/2-inch (13-mm) airspace at sides and ends of wood members.
- C. Install wood posts using metal anchors indicated.
- D. Treat ends of timber beams and posts exposed to weather by dipping in water-repellent preservative for 15 minutes.

#### 3.7 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

SECTION 061600 - SHEATHING

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Wall sheathing.
  - 2. Roof sheathing.
  - 3. Building paper.
- B. Related Sections:
  - 1. Division 7 Section "Sheet metal flashing and trim" for self-adhered membrane flashing"

### 1.2 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment and fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.

## 1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

#### PART 2 - PRODUCTS

- 2.1 WOOD PANEL PRODUCTS, GENERAL
  - A. Plywood: Either DOC PS 1, unless otherwise indicated.

#### 2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA C9.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers and waterproofing.

## 2.3 WALL SHEATHING

- A. Exterior Wood Structural Panel Wall Sheathing: Plywood or OSB: Grade C-D Exposure 1, structural I, exterior glue in conformance with DPC PS 1.
- B. Shear Wall Wood Structural Panel Sheathing: Plywood or OSB: Grade C-D Exposure 1, structural I, exterior glue in conformance with DPC PS 1.

### 2.4 ROOF SHEATHING

A. Wood Structural Panel Roof Sheathing: Plywood or OSB: Grade C-D Exposure 1, structural I, exterior glue in conformance with DPC PS 1.

#### 2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated.
  - 1. For wall and roof sheathing panels, provide fasteners with corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

#### 2.6 WEATHER-RESISTANT SHEATHING PAPER

A. Building Paper: ASTM D 226, Type 1 (No. 15 asphalt-saturated organic felt), unperforated.

#### 2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use indicated by manufacturers of both adhesives and panels.

### PART 3 - EXECUTION

- 3.1 INSTALLATION, GENERAL
  - A. Securely attach to substrate by fastening as indicated.
  - B. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that exclude exterior moisture.
  - C. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

## 3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."
  - 1. Comply with "Code Plus" installation provisions in guide referenced in paragraph above.
- B. Fastening Methods: Fasten panels as indicated below:
  - 1. Wall and Roof Sheathing:
    - a. Nail to wood framing.

## 3.3 WEATHER-RESISTANT SHEATHING PAPER INSTALLATION

- A. General: Cover sheathing with weather-resistant sheathing paper as follows:
  - 1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
  - 2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap, unless otherwise indicated.
- B. Building Paper: Apply horizontally with a 2-inch (50-mm) overlap and a 6-inch (150-mm) end lap; fasten to sheathing with galvanized staples or roofing nails.
- C. Coordinate with installation of Self-adhered membrane flashing.

### SECTION 061700 – LAMINATED STRAND LUMBER

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

A. This Section includes the complete furnishings and installation of all Laminated Strand Lumber (LSL) (Timber Strand Trademark) Lumber as shown on the drawings specified herein, with all accessories necessary to complete the work.

### 1.3 CODE APPROVALS

- A. These products shall be designed and manufactured to the standards set forth in the National Evaluation Service, Inc. (NES) Report No. NER-481.
  - 1. Division 6 Section "Rough Carpentry".
  - 2. Division 6 Section "Metal-Web Wood Joists".
  - 3. Division 6 Section "Pre-Fabricated Wood I-Joists".

#### 1.4 SUBMITTALS

- A. Division 1 Section Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Shop drawings showing layout and detail necessary for determining fit and placement in the building.

#### PART 2 - PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS

- A. Laminated Strand Lumber (LSL) shall be manufactured by Trus Joist under an approved third party inspection agency or approved as indicated below.
- B. Substitutions: Division 1 Section Product Requirements.

## 2.2 MATERIALS

A. Code Reports: Materials shall comply with NES Report No. NER-481.

#### LAMINATED STRAND LUMBER

- B. Manufacturing Process: Laminated Strand Lumber (LSL) shall be manufactured from strands oriented to the length of the member and then fed into a press. All members are to be free of finger or scarf joints or mechanical connections in full-length members.
- C. Adhesives: Adhesives shall be of the waterproof conforming to the requirements of ASTM D-2559.

### 2.3 TOLERANCES

- A. Finished Length (as specified)  $\pm 1/8$ ".
- B. Depth:  $\pm 1/16$ ", -0 (Rim Board)  $\pm 1/16$ ", -0 (all other products).
- C. Width:  $\pm 1/6"$

## 2.4 IDENTIFICATION

A. Laminated Strand Lumber (LSL) shall be identified by a stamp indicating the product type and grade, NER report number, manufacturer's name, plant number and the independent inspection agency's logo.

#### 2.5 HARDWARE

A. All hardware is to be fabricated by others according to the details contained in the contract documents.

## PART 3 - EXECUTION

### 3.1 ERECTION AND INSTALLATION

- A. Storage, Handling and Erection
  - 1. Laminated Strand Lumber (LSL), if stored prior to erection, shall be protected from the weather. It shall be erected and installed in accordance with the plans and any manufacturer drawings and installation suggestions that may be provided. Temporary construction loads that cause stresses beyond design limits are not permitted. Holes, cuts, or notches not previously approved by the engineer shall not be permitted. The final erection of Laminated Strand Lumber (LSL), shall be under the direction of qualified personnel.

#### 3.2 PERFORMANCE STANDARDS

A. Products shall be proven by testing and evaluation in accordance with the provisions of ASRM D-5456.

## 3.3 FIRE RATING

A. Laminated Strand Lumber (LSL) may be used in fire-resistive assemblies as a substitute for conventional wood framing. Laminated Strand Lumber (LSL), shall be sized for the same load-carrying capacity as the solid-sawn lumber specified in the assembly, and its dimensions shall be equal to or greater than those specified for the solid-sawn lumber. Laminated Strand Lumber (LSL) may also be used in lieu of conventional wood for fire blocking (1-1/4" net thickness)

## SECTION 061733 – PRE-FABRICATED PLYWOOD I JOISTS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. This Section includes wood chord and plywood or particleboard web joists for floor framing; bridging, bracing and anchorage; framing for openings; and preservative treatment of wood.
- B. Related Sections include the following:
  - 1. Division 6 Section "Rough Carpentry".
  - 2. Division 6 Section "Sheathing".
  - 3. Division 6 Section "Laminated Strand Lumber"
  - 4.
  - 5. Division 6 Section "Metal Web Wood Joists".

#### 1.3 REFERENCES

- A. APA Engineered Wood Association:
  - 1. APA/EWA PSI 400 Performance Standard for Wood I Joists.
- B. American Society for Testing and Materials:
  - 1. ASTM D2559 Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions.
- C. American Wood-Preservers' Association:
  - 1. AWPA C1 All Timber Products Preservative Treatment by Pressure Process.
- D. National Evaluation Service (NES): Report No. NER-200.

## 1.4 ACTION SUBMITTALS

A. Shop Drawings: Provide shop drawings which indicate sizes and spacings of joists, fastener description and spacings, loads, framed openings, stamped by a professional engineer licensed in the State of Oregon. Submit joist configurations, bearing and anchor details, bridging and bracing.

B. Design Calculations: Submit design calculations that conform to the dimensions and design loads shown in the drawings, stamped by a professional engineer licensed in the State of Oregon.

## 1.5 INFORMATIONAL SUBMITTALS

A. Evaluation reports, from ICC-ES.

### 1.6 DESIGN REQUIREMENTS

- A. Design members and their connections to supporting structure for the more stringent of the applied loads and deflection limitations shown on the drawings or as required by the applicable building code.
- B. Where joist size and spacing is indicated on the drawings, products with a lesser strength or stiffness (EI) shall not be substituted nor shall equivalent products at a larger spacing.

### 1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
  - 1. I-Joist Quality Assurance Agency.
  - 2. Manufacturers Requirements.
  - 3. National Evaluation Services (NES) Report NO. NER-200.
  - 4. APA Design/Construction Guide: I Joists for Residential Floors (Form x 710).

#### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Design joists and associated components under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of Oregon.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Division 1 Section Product Requirements: Product storage and handling requirements.
- B. Protect structural components from warping or distortion by stacking in vertical position, braced to resist movement. Protect from weather by covering with waterproofing sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

## ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON

### 2.1 MANUFACTURERS

- A. Manufacturers:
  - 1. Boise Cascade Corporation.
  - 2. Georgia-Pacific.
  - 3. Louisiana-Pacific Corporation.
  - 4. Pacific Woodtech Corporation.
  - 5. RedBuilt LLC
  - 6. Roseburg Forest Products Co.
  - 7. Stark Truss Company, Inc.
  - 8. Weyerhaeuser Company.

### 2.2 ACCESSORIES

- A. Adhesive: ASTM D2559.
- B. Wood Blocking, Support Members and Framing for Openings, beveled plates.
- C. Fasteners:
  - 1. Fasteners: Hot dipped galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.

#### 2.3 FABRICATION

- A. Fabricate joists to achieve structural requirements specified.
- B. Brace members for support during transit.
- C. Fabricate to achieve minimum end bearing per manufacturer's requirements.
- D. Frame special sized openings in web as indicated on Drawings.

#### 2.4 FACTORY WOOD TREATMENT

A. Wood Preservative (Pressure Treatment): AWPA Treatment C1 using water borne preservative with 0.25 lbs/cu ft retention.

## 2.5 MATERIALS

- A. Flange Material: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
- B. Web Material: Either oriented strand board or plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1.

- C. Structural Properties: Provide units matching the depths indicated and with design strength and stiffness (EI) values not less than those indicated.
- D. Provide units complying with APA PRI-400, factory marked with APA trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA standard.

### 2.6 DENTIFICATION

A. Each of the joists shall be factory marked with APA trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA standard.

# PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Division 1 Section Administrative Requirements: Coordination and project conditions.
- B. Verify supports and openings are ready to receive joists.

#### 3.2 PREPARATION

A. Coordinate placement and bearing and support items.

#### 3.3 ERECTION

- A. Install products to comply with manufacturer's written instructions.
- B. Set structural members level and plumb, in correct position.
- C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners in each intended fastener hole.
- D. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing.
- E. Do not field cut or alter structural members without approval of Architect/Engineer.
- F. Do not splice members between supports unless otherwise indicated.
- G. Place headers and supports to frame openings.
- H. Frame openings between joists with lumber and provide blocking and framing as required to support facing materials, fixtures, specialty items and trim in accordance with Division 6 Section "Rough Carpentry".

- I. Coordinate placement of sheathing with work of this Section.
- 3.4 STORAGE AND HANDLING
  - A. Joists shall be stored in a vertical position and protected from the weather.

## 3.5 ERECTION TOLERANCES

- A. Division 1 Section Quality Requirements: Tolerances.
- B. Framing Members: 1/2" maximum, from indicated position.

SECTION 061736 – METAL-WEB WOOD JOISTS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes wood chord metals joists for floor framing; bridging, bracing and anchorage; framing for openings; and preservative treatment of wood.
- B. Related Sections include the following:
  - 1. Division 6 Section "Rough Carpentry".
  - 2. Division 6 Section "Laminated Strand Lumber"
  - 3. Division 6 Section "Pre-Fabricated Wood I-Joists".

#### 1.3 REFERENCES

- A. American Wood-Preservers' Association:
  - 1. AWPA C1 All Timber Products Preservative Treatment by Pressure Process.

#### 1.4 DESIGN REQUIREMENTS

A. Design loads and deflections as shown on drawings.

#### 1.5 SUBMITTALS

- A. Division 1 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate size and spacing of joists, fastener description and spacings, loads, framed openings stamped by a professional engineer licensed in the State of Oregon. Submit joist configurations, bearing and anchor details, bridging and bracing.
- C. Design Calculations: Submit design calculations that conform to the dimensions and design loads shown in the drawings, stamped by a professional engineer licensed in the State of Oregon.

## 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
  - 1. I-Joist Quality Assurance Agency.
  - 2. Manufacturers Requirements.
  - 3. National Evaluation Services (NES) Report NO. NER-148.
- B. Quality Standard: Comply with AITC A190.1, "Structural Glued Laminated Timber."

### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Design joists and associated components under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of Oregon.
- 1.8 DELIVERY, STORAGE, AND HANDLING
  - A. Division 1 Section Product Requirements: Product storage and handling requirements.
  - B. Protect joists from warping or other distortion by stacking in vertical position, braced to resist movement.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers:
  - 1. Trus Joist.
  - 2. Substitutions: Division 1 Section Product Requirements.

### 2.2 MATERIALS

- A. Wood Chord Members: Laminated Veneer Lumber (LVL) or Machine Stress Rated (MSR) Lumber, 1-1/2" x 3-1/2" minimum.
- B. Web Members: Cold rolled steel tubing, hot dip galvanized, minimum yield strength of 40,000 psi, accurately die stamped, electrically welded.
- C. Connecting Pins: Hot dip galvanized structural carbon steel.
- D. Joist Bridging: Type, size and spacing recommended by joist manufacturer.
- 2.3 ACCESSORIES

A. Wood Blocking, Support Members, Framing for Openings, beveled plates.

### 2.4 FABRICATION

- A. Fabricate joists to achieve structural requirements specified.
- B. Brace members for support during transit.
- C. Fabricate to achieve minimum end bearing per manufacturer's requirements.
- D. Frame special sized openings in web as indicated on Drawings.

#### 2.5 FACTORY WOOD TREATMENT

A. Wood Preservative (Pressure Treatment): AWPA Treatment C1 using water borne preservative with 0.25 lbs/cu ft retention.

#### 2.6 TOLERANCES

- A. Length +/- 1/8".
- B. Depth +/- 1/16".

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Division 1 Section Administrative Requirements: Coordination and project conditions.
- B. Verify supports and openings are ready to receive joists.

#### 3.2 PREPARATION

A. Coordinate placement and bearing and support items.

#### 3.3 ERECTION

- A. Set members level and plumb, in correct position.
- B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing.
- C. Do not field cut or alter structural members without approval of Architect/Engineer.

- D. Place headers and supports to frame openings.
- E. Frame openings between joists with lumber in accordance with Division 6 Section "Rough Carpentry".
- F. Coordinate placement of sheathing with work of this Section.
- G. After erection, touch-up damaged galvanized surfaces with primer consistent with shop coat.
- 3.4 ERECTION TOLERANCES
  - A. Division 1 Section Quality Requirements: Tolerances.
  - B. Framing Members: 1/2" maximum, from indicated position.

### SECTION 061800 - GLUED-LAMINATED CONSTRUCTION

### 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 framing using structural glued-laminated timber.
- B. Related Sections:
  - 1. Division 06 Section "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.

## 1.3 DEFINITIONS

A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

#### 1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Structural glued-laminated timber and connectors shall withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in AITC 117 or determined according to ASTM D 3737 and acceptable to authorities having jurisdiction.

### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include data on lumber, adhesives, fabrication, and protection.
  - 2. For preservative-treated wood products, include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
  - 3. For connectors, include installation instructions.
- B. Shop Drawings:
  - 1. Show layout of structural glued-laminated timber system and full dimensions of each member.
  - 2. Indicate species and laminating combination, adhesive type, and other variables in required work.
  - 3. Include large-scale details of connections.

#### GLUED-LAMINATED CONSTRUCTION

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide factory-glued structural units produced by an AITC- or APA-licensed firm that is certified for chain of custody by an FSC-accredited certification body.
  - 1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that will not be exposed in the completed Work.
- B. Quality Standard: Comply with AITC A190.1.
- C. Forest Certification: Provide structural glued-laminated timber produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.
  - 1. Provide structural glued-laminated timber made from single species.
  - 2. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.
  - 3. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.
    - a. Use adhesive that contains no urea-formaldehyde resins.
- B. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch in grades needed to comply with "Performance Requirements" Article.
- C. Species and Grades for Beams and Purlins:
  1. Species and Beam Stress Classification: Ref General Structural notes.
- D. Appearance Grade: Architectural complying with AITC 110.
- E. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- F. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

## 2.2 TIMBER CONNECTORS

- A. General: Unless otherwise indicated, fabricate from the following materials:
  1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.
- B. Provide bolts, 3/4 inch (19 mm) unless otherwise indicated, complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); nuts complying with ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

### 2.3 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
  - 1. Dress exposed surfaces as needed to remove planing and surfacing marks.
- B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- C. End-Cut Sealing: Immediately after end cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

### PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of structural glued-laminated timber.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. General: Erect structural glued-laminated timber true and plumb, and with uniform, closefitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
  - 1. Lift with padded slings and protect corners with wood blocking.
  - 2. Install structural glued-laminated timber to comply with Shop Drawings.
  - 3. Install timber connectors as indicated.
- B. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing and finishing.
  - 1. Predrill for fasteners using timber connectors as templates.
  - 2. Dress exposed surfaces as needed to remove planing and surfacing marks.
  - 3. Coat cross cuts with end sealer.

C. Cutting: Avoid cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

## 3.3 ADJUSTING

A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

### 3.4 **PROTECTION**

A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose including protection from weather, sunlight, soiling, and damage from work of other trades.

## SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

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. Plastic-laminate-faced architectural cabinets.
  - 2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.
- B. Related Requirements:
  - 1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including panel products high-pressure decorative laminate adhesive for bonding plastic laminate and cabinet hardware and accessories.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 2. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
  - 3. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples for Verification:
  - 1. Wood-grain plastic laminates, 12 by 24 inches (300 by 600 mm), for each pattern and surface finish, with one sample applied to core material and specified edge material applied to one edge.
  - 2. Corner pieces as follows:

- a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.
- b. Miter joints for standing trim.
- 3. Exposed cabinet hardware and accessories, one unit for each type and finish.

## 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful inservice performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Testing Agency Qualifications: For testing agency providing classification marking for fireretardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of typical plastic-laminate cabinet as shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

## 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.
- C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

### 1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

## PART 2 - PRODUCTS

## 2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
  - 1. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
- B. Grade: Custom.
- C. Cabinet, Door, and Drawer Front Interface Style: Reveal overlay.
- D. Reveal Dimension: 1/2 inch (13 mm).
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
- F. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Wilsonart International Holdings, Inc.
    - a. Harvest Maple 7953-38
- G. Laminate Cladding for Exposed Surfaces:
  - 1. Horizontal Surfaces: Grade HGS.
  - 2. Postformed Surfaces: Grade HGP.
  - 3. Vertical Surfaces: Grade HGS.
  - 4. Edges: Grade HGS PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
  - 5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

- H. Materials for Semi-exposed Surfaces:
  - 1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semi-exposed surfaces unless otherwise indicated.
    - a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
- I. Dust Panels: 1/4-inch (6.4-mm) above compartments and drawers unless located directly under tops.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
  - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. As indicated by laminate manufacturer's designations.

## 2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
  - 1. Medium-Density Fiberboard: ANSI A208.2, Grade 130.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."
- B. Butt Hinges: 2-3/4-inch (70-mm), five-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:
  - 1. Semi-concealed Hinges for Overlay Doors: dark bronze. Each hinge to have minimum nine screws, #7, 5/8 inch FHMS to assure positive door attachment.

- C. Wire Pulls: Back mounted, solid metal, 5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.
- D. Catches: Roller catches, BHMA A156.9, B03071.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- F. Drawer Slides: BHMA A156.9, with positive stops in both directions.
  - 1. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
  - 2. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 2.
  - 3. For drawers more than 3 inches (75 mm) high but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1HD-100.
  - 4. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-200.
- G. Door Locks: Camlock, dark bronze finish.
- H. Door and Drawer Silencers: clear rubber, self-adhered.
- I. Exposed Hardware Finishes: For exposed hardware, provide dark bronze finish.
- J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- K. Vents: Tall classroom wardrobe cabinets show vents (See drawings). Provide 9"h x 12"w aluminum mesh vents with dark bronze matte finish.

## 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrousmetal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
  - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.5 FABRICATION

- A. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Corners of Cabinets: 1/16 inch (1.5 mm) unless otherwise indicated.

- B. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
  - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

## 2.6 SHOP FINISHING

- A. General: Finish architectural cabinets at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural cabinets, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

# PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

### 3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
  - 1. Use filler matching finish of items being installed.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
  - 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips.

#### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semi-exposed surfaces.

## SECTION 071113 - BITUMINOUS DAMPPROOFING

## 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. Cold-applied, emulsified-asphalt dampproofing applied to foundation walls.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for bituminous vapor retarders.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

#### 1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

# PART 2 - PRODUCTS

### 2.1 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- 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. ChemMasters, Inc.
  - 2. Gardner-Gibson, Inc.
  - 3. Henry Company.
  - 4. Karnak Corporation.
  - 5. Koppers Inc.
  - 6. Malarkey Roofing Company.
  - 7. W. R. Meadows, Inc.

- B. Trowel Coats: ASTM D 1227, Type II, Class 1.
- C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
- D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

### 2.2 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Cut-Back-Asphalt Primer: ASTM D 41.
- C. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- D. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- E. Patching Compound: Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.
- F. Protection Course: ASTM D 6506, 1/8-inch- (3-mm-) thick, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.
  - 1. Test for surface moisture according to ASTM D 4263.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.

C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

### 3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
  - 1. Apply dampproofing to provide continuous plane of protection.
  - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.
  - 1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
  - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch (6 mm) onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
  - 1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
  - 2. Lap dampproofing at least 1/4 inch (6 mm) onto shelf angles supporting veneer.

### 3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations and Parged Masonry Foundation Walls: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).
- B. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

#### 3.5 INSTALLATION OF PROTECTION COURSE

A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

- 1. Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.
- 2. Install protection course on same day within 24 hours of installation of dampproofing (while coating is tacky) to ensure adhesion.

## 3.6 CLEANING

A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

SECTION 071900 - WATER REPELLENTS

### 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 film-forming water-repellent treatments for the following vertical and horizontal surfaces:
  - 1. Cast-in-place concrete.
  - 2. Brick masonry.
- B. Related Requirements:
  - 1. Section 042113 "Brick Masonry" for integral water-repellent admixture for unit masonry assemblies.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include manufacturer's printed statement of VOC content.
  - 2. Include manufacturer's standard colors.
  - 3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of water repellent.
- B. Preconstruction Test Reports: For water-repellent-treated substrates.
- C. Sample Warranty: For special warranty.

### 1.5 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

- B. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Locate mockups in locations that enable viewing under same conditions as the completed Work.
    - a. Size: 10 sq. ft. (9.3 sq. m) each.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

### 1.6 FIELD CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
  - 1. Concrete surfaces and mortar have cured for not less than 28 days.
  - 2. Building has been closed in for not less than 30 days before treating wall assemblies.
  - 3. Ambient temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C) and will remain so for 24 hours.
  - 4. Substrate is not frozen and substrate-surface temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C).
  - 5. Rain or snow is not predicted within 24 hours.
  - 6. Not less than 24 hours have passed since surfaces were last wet.
  - 7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

## PART 2 - PRODUCTS

### 2.1 FILM-FORMING WATER REPELLENTS

- A. Silicone-Resin Sealer, Film-Forming Water Repellent: Clear, polymerized, silicone-resin water repellent for dense substrates; in a solvent- or waterborne solution containing not less than 3 and up to 7 percent solids by weight; and with 400 g/L or less of VOCs.
  - 1. Manufacturers: Basis of Design Products: Subject to compliance with requirements, provide Diedrich Technologies, Inc., 333 Omegaseal Water Repellent or a comparable product by one of the following:
    - a. ChemMasters.
    - b. H&C Concrete Care products, Sherwin-Williams Company.
    - c. Professional Products of Kansas, Inc.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
  - 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
  - 2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
  - 3. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.
- B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions.
- C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
- D. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- E. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
  - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

### 3.3 APPLICATION

A. Apply as recommended by manufacturer to achieve coverage required to function as an Anti-Graffiti System.

- B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
- C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

## 3.4 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.
SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2 SUMMARY `
  - A. Section Includes:
    - 1. Extruded polystyrene foam-plastic board insulation.
    - 2. Glass-fiber blanket insulation.
    - 3. Vapor Retarders
  - B. Related Sections:
    - 1. Section 075419 Polyvinyl-Chloride (PVC) Roofing for insulation specified as part of roofing construction.

## 1.3 ACTION SUBMITTALS

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

## 1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

## 1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

- B. Protect foam-plastic board insulation as follows:
  - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
  - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

# PART 2 - PRODUCTS

# 2.1 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. DiversiFoam Products.
    - b. Dow Chemical Company (The).
    - c. Owens Corning.
    - d. Pactiv Building Products.
  - 2. Type IV, 25 psi.
  - 3. Thickness: As required to provide minimum R-15 at foundation and slab perimeters.
- B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

#### 2.2 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. CertainTeed Corporation.
  - 2. Guardian Building Products, Inc.
  - 3. Johns Manville.
  - 4. Knauf Insulation.
  - 5. Owens Corning.
- B. Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
  - 1. Thickness: As required, per the wall types on the drawings, at exterior walls.

- C. Glass-Fiber Blanket, Unfaced (for interior wall cavity insulation): ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- D. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
  - 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
  - 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

# 2.3 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
    - b. Gemco; Spindle Type.
  - 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanizedsteel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
  - 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. AGM Industries, Inc.; RC150 or SC150.
    - b. Gemco; Dome-Cap R-150 or S-150.
  - 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.
- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
  - 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. AGM Industries, Inc.; TACTOO Adhesive.
    - b. Gemco; Tuff Bond Hanger Adhesive.

# 2.4 VAPOR RETARDERS

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturer for sealing joints and penetrations in vapor retarder.

# PART 3 - EXECUTION

# 3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

# 3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsolled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

# 3.3 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
  - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
  - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

# 3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass-Fiber Insulation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  - 4. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:
    - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
  - 5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
    - a. Exterior Walls: Set units with facing placed toward exterior of construction as indicated on Drawings.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
  - a. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

#### 3.5 INSTALLATION OF VAPOR RETARDERS

- A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
  - 1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

1. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

# 3.6 **PROTECTION**

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

#### END OF SECTION 072100

SECTION 072500 - WEATHER BARRIERS

# PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Vapor-permeable weather barrier membrane and joint tape.
  - 2. Flexible membrane flashing.
  - 3. Base joint termination flashing.
  - 4. Primers for flashing on concrete.

# 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.
- B. Shop Drawings: Comply with requirements in Division 1 for submittal procedures.
- C. Product Data: Submit manufacturers' current product data sheets, details and installation instructions for the water-resistive vapor permeable air barrier and drainage matrix membrane components and accessories.
- D. Manufacturer Instructions: Submit manufacturer's written installation instructions.

## 1.4 QUALITY ASSURANCE

- A. Qualifications: Installer shall a minimum of 2 years experience with installation of commercial sheet good weather barrier assemblies. Installer shall be acceptable to manufacturer.
- B. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.
- C. Compliance with Standards: Products shall meet or exceed the requirements of AATC 127, ASTM D 882, ASTM E 84, ASTM E 96, ASTM E 2178, ASTM E 2357, ASTM E 330, ASTM D 5034, ASTM D 1970, and ASTM D 3330.

- D. Mock-Up: Install a mock-up using approved weather barrier system including membrane, flashing, joint and detailing tape and related weather barrier accessories according to weather barrier manufacturer's current printed instructions and recommendations.
  - 1. Mock-up Size: 10 by 10 feet, in a location on the building.
  - 2. Mock-up Substrate: Match wall assembly construction, including window opening.
  - 3. Mock-up may remain as part of the work.
  - 4. Arrange for manufacturer's designated representative prior to weather barrier system installation, to perform required mock-up visual inspection and analysis as required for warranty.

# 1.5 PRE-INSTALLATION MEETING

- A. Convene a pre-installation conference, a minimum of two weeks prior to start of weather barrier installation. Attendees shall include Contractor, Architect, installer, and weather barrier manufacturer's designated field representative.
- B. Review all related project requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of weather barrier system materials and components, installer's training requirements, equipment, facilities and scaffolding. Coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.
- C. Review requirements for sequencing of installation of weather barrier system with installation of windows, doors, louvers and metal flashings to provide a weather-tight barrier system. Schedule installation of exterior cladding within three months of weather barrier system installation.
- 1.6 Review requirements for sequencing of installation of weather barrier system with installation of windows, doors, louvers and metal flashings to provide a weather-tight barrier system. Schedule installation of exterior cladding within three months of weather barrier system installation.

#### 1.7 WARRANTY

A. Manufacturer Warranty: Submit manufacturer's standard 10-year warranty for weather barrier against defects in materials.

PART 2 - PRODUCTS

# 2.1 WEATHER BARRIERS

# 2.2 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

# 2.3 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbs/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E 2357.

# 2.4 WEATHER BARRIER

- A. Vapor-Permeable Weather Barrier Membrane: product shall be a 3-layer (one functional layer with protective fiber layer on each face) product providing resistance to air flow, bulk water and wind driven rain which allows moisture vapor to escape.
- B. Flexible Sealing Tape: a self-adhered vapor permeable tape to seal joints
- C. Flexible Membrane Flashing: a self-adhered vapor permeable tape to seal around window and door, seams and penetrations.
- D. Base Joint Termination Adhesive: pre-cured acrylic adhesive.
- E. Primers for Flashing: primer, as recommended for applicable substrates.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide products by SIGA Cover Inc.; SIGA Majvest and accessory components as indicated in product requirements or comparable product by one of the following:
    - a. DuPont; Tyvek CommercialWrap
    - b. Henry; Blueskin VP160

# PART 3 - EXECUTION

# 3.1 EXAMINATION

- A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.
- 3.2 INSTALLATION
  - A. Install materials in strict accordance with manufacturer's instructions. Surfaces shall be clean and free of frost, oil, grease, mold and efflorescence prior to application of flashing.
  - B. Membrane Joint Treatment: Membrane shall be installed in manor consistent with the Project details. Membrane end and lateral laps shall be a minimum of 4 inches. Membrane laps shall be sealed and taped.
  - C. Vapor Permeable Flexible Tape Flashing at Window Openings:
    - 1. At sills, jambs and head of rough opening apply flashing tape to a depth as indicated in details and a minimum of 3 inches outside face of opening over the weather-resistive barrier unless detailed otherwise.
    - 2. Counter flash window exterior after window installation with flashing. Size as indicated in details.
  - D. Flexible Flashing at Penetrations: Comply with manufacturer's details for flashing of miscellaneous penetrations such as vents, pipes and similar items.
  - E. Membrane Termination at Base Joint: Comply with manufacturer's recommendations based on substrate.

# 3.3 FIELD QUALITY CONTROL

- A. Notify weather barrier manufacturer's designated representative to obtain periodic observations of weather barrier system installation if required. Notification shall be a minimum of 30 days prior to the start of installation. Notice of final inspection shall be made 30 days prior to completion.
- B. Inspections: Weather barrier materials, accessories, and installation are subject to inspection for compliance with performance requirements. Repair damage to weather barriers caused by destructive testing; follow manufacturer's written instructions.

# 3.4 PROTECTION AND CLEANING

A. Protect weather barrier from contact with incompatible materials and sealants not approved per weather barrier manufacturer's recommendation.

B. Protect installed weather barrier system from damage during construction prior to cladding installation.

END OF SECTION 072500

SECTION 072600 - VAPOR RETARDERS

# 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. Reinforced-polyethylene vapor retarders in wall assembly
  - 2. Under-slab reinforced-polyethylene vapor retarders.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete".
  - 2. Section 312000 "Earth Moving" for capillary course.

#### 1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
  - 1. ASTM E 1745-97 (2004) Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
  - 2. ASTM E 154-88 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.
  - 3. ASTM E 1249-95 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
  - 4. ASTM E 1643-98 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- B. American Concrete Institute (ACI):
  - 1. ACI 302.1R-04 Vapor Barrier Component (plastic membrane) is not less than 10 mils thick.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

# 1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

# PART 2 - PRODUCTS

# 2.1 REINFORCED-POLYETHYLENE VAPOR RETARDERS (VAPOR BARRIER)

- A. Reinforced-Polyethylene Vapor Retarders:
  - 1. Sheet with outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim.
  - 2. Manufacturers: Subject to compliance with requirements provide products by one of the following:
    - a. Insulation Solutions, Inc.
    - b. Raven Industries Inc.
    - c. Reef Industries, Inc.
  - 3. Material
    - a. Weight: not less than 29 lb/1000 sq. ft. (13 kg/100 sq. m
    - b. Permeance Rating: Less than 0.1 perm (5.7 ng/Pa x s x sq. m) per ASTM E96 and ASTM E154.
    - c. Classification: ASTM E1745 Class C
    - d. Puncture Resistance: Greater than 1500 grams per ASTM D1709
    - e. Tensile Strength
      - 1) New Material: 32 lbs per inch (56 N/cm) per ASTM E154.
      - 2) After Soaking: 25 lbs per inch (44N/cm) per ASTM E154.

# 2.2 UNDER-SLAB VAPOR RETARDER

- 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. Insulation Solutions, Inc.
  - 2. Raven Industries.
  - 3. Stego Industries.
  - 4. W.R. Meadows, Inc.

# 2.3 MATERIALS

A. Vapor retarder membrane must have the following properties:

1.	Minimum Permeance	ASTM E96	0.04 Perms
2.	Water Vapor Barrier	ASTM E1745	Meets or exceeds Class A.
3.	Thickness of Barrier (plastic)	ACI 302.1 R96	Not less than 15 mils

#### 2.4 ACCESSORIES

- A. Seaming Tape: Manufacturer's standard 4-inch seaming tape.
- B. Pipe Boot Kits: Manufacturer's standard pipe boot kits.

#### 2.5 ACCESSORIES

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

# PART 3 - EXECUTION

# 3.1 PREPARATION

A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

## 3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Place vapor retarders on side of construction indicated on Drawings.
- B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

# 3.3 INSTALLATION OF UNDER-SLAB VAPOR RETARDER

- A. Install under-slab vapor retarder in accordance with manufacturer's instructions and ASTM E 1643-98.
  - 1. Unroll vapor retarder with the longest dimension parallel with the direction of the pour.
  - 2. Lap vapor retarder over footings and seal to foundation walls.
  - 3. Overlap joints 6 inches and seal with manufacturer's tape.
  - 4. Seal all penetrations (including pipes) per manufacturer's instructions.
  - 5. No penetration of the vapor retarder is allowed except for reinforcing steel and permanent utilities.
  - 6. Repair damaged areas by cutting patches of vapor retarder, overlapping damaged area 6 inches and taping all four sides with tape.

# 3.4 **PROTECTION**

A. Protect vapor retarders from damage until concealed by permanent construction.

# END OF SECTION 072600

# SECTION 074213.13 - FORMED METAL WALL PANELS

# PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

# 1.2 SUMMARY

- A. Section Includes:
  - 1. Concealed-fastener, lap-seam metal wall panels.

# 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 each type of panel and accessory.
- B. Shop Drawings:
  - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.
  - 1. Include Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
  - 1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal panel accessories.

# 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

# FORMED METAL WALL PANELS

- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

# 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

# 1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

# 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

# 1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

## 1.9 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

# 1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:
  - a. Structural failures including rupturing, cracking, or puncturing.
  - b. Deterioration of metals and other materials beyond normal weathering.
- 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

# PART 2 - PRODUCTS

# 2.1 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Smooth, Concealed-Fastener Metal Wall Panels:
  - 1. Manufacturer: AEP Span (or approved equal).
  - 2. Product: Prestige Series (PS-12)
  - 3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    - a. Gage: 18 gage (1.19mm).
    - b. Exterior Finish: Two-coat fluoropolymer.
    - c. Colors: As indicated on drawings.
    - d. Panel Lengths: Full length, custom, per building elevations.
    - e. Panel profiles:
      - 1) A = No reveal (Full 12" panel)
      - 2) B = 1" Reveal (11 up / 1 down panel)
      - 3)  $C = 2^{"}$  Reveal (10 up / 2 down panel)

- 4) D = 6" Reveal (6 up / 6 down panel).
- f. Siding Layout: see building elevations for orientation and metal panel pattern utilizing the profiles listed above.

# 2.2 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
  - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

# 2.3 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flatlock seams. Tin edges to be seamed, form seams, and solder.
  - 3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

# 2.4 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable

if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- C. Steel Panels and Accessories:
  - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

# 2.5 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Successfully tested to ASTM E330 to wind pressures meeting or exceeding the design pressures on exterior walls.
- B. Fire Resistance: Successfully tested to NFPA 285, an intermediate scale fire test, or be noncombustible.

# PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
  - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

# 3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

# 3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving metal panels.
  - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as metal panel work proceeds.
  - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
  - 1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
  - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
  - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
  - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
  - 5. Flash and seal panels with weather closures at perimeter of all openings.

# E. Watertight Installation:

- 1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
- 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
- 3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
  - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

# 3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.13

# SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

# PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Adhered polyvinyl-chloride (PVC) roofing system.
  - 2. Mechanically fastened polyvinyl-chloride (PVC) roofing system.
  - 3. Loosely laid and ballasted polyvinyl-chloride (PVC) roofing system.
  - 4. Vapor retarder.
  - 5. Roof insulation.
- B. Related Requirements:
  - 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for woodbased, structural-use roof deck panels.
  - 2. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
  - 3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
  - 4. 079500 Expansion Control
  - 5. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

#### 1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

# 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:
  - 1. Base flashings and membrane terminations.
  - 2. Tapered insulation, including slopes.
  - 3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.

- 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products:
  - 1. Sheet roofing, of color required.
  - 2. Aggregate surfacing material in gradation required.
  - 3. Walkway pads or rolls, of color required.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
  - 1. Submit evidence of compliance with performance requirements.
- C. Product Test Reports: For components of roofing system, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

# 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
  - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

#### 1.9 FIELD 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.

# 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Special warranty includes membrane roofing, base flashings, and other components of roofing system.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

# PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. Source Limitations: Obtain components including roof insulation fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

# 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
  - 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.

- 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:
  - 1. Corner Uplift Pressure: Per Structural drawings.
  - 2. Perimeter Uplift Pressure: Per Structural drawings.
  - 3. Field-of-Roof Uplift Pressure: Per Structural drawings.
- D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

#### 2.3 PVC ROOFING

- A. PVC Sheet: ASTM D 4434/D 4434M, Type III, fabric reinforced.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Sika Sarnafil.
  - 2. Thickness: 60 mils (1.5 mm), nominal.
  - 3. Exposed Face Color: White.

# 2.4 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
  - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.
- C. Bonding Adhesive: Manufacturer's standard.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.

- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch (25 mm wide by 1.3 mm) thick, prepunched.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosionresistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

# 2.5 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (13 mm), Type X, 5/8 inch (16 mm) thick within 48" of fire walls.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Georgia-Pacific Building Products.
    - c. National Gypsum Company.
    - d. Temple-Inland Building Products by Georgia-Pacific.
    - e. United States Gypsum Company.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

#### 2.6 VAPOR RETARDER

- A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).
  - 1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- B. Self-Adhering-Sheet Vapor Retarder: ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil- (1.0-mm-) total thickness; maximum permeance rating of 0.1 perm (6 ng/Pa x s x sq. m); cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.
- C. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt impregnated.

# 2.7 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by PVC roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Atlas Roofing Corporation.
    - b. Carlisle SynTec Incorporated.
    - c. Hunter Panels.
    - d. Johns Manville; a Berkshire Hathaway company.
  - 2. Thickness: As required to provide minimum R-30.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

#### 2.8 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosionresistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer.

# 2.9 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

# PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
  - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
  - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

# 3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

# 3.4 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
  - 1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

# 3.5 VAPOR-RETARDER INSTALLATION

- A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively. Continuously seal side and end laps with tape.
- B. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install selfadhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches (90 mm) and 6 inches (150 mm), respectively. Seal laps by rolling.
- C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

# 3.6 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
  - 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- G. Mechanically Fastened and Adhered Insulation: Install each layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
  - 1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
  - 2. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

- H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.
  - 1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

# 3.7 MECHANICALLY FASTENED ROOFING INSTALLATION

- A. Mechanically fasten roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.
  - 1. Install sheet according to ASTM D 5082.
  - 2. For in-splice attachment, install roofing with long dimension perpendicular to steel roof deck flutes.
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically fasten or adhere roofing securely at terminations, penetrations, and perimeter of roofing.
- E. Apply roofing with side laps shingled with slope of roof deck where possible.
- F. In-Seam Attachment: Secure one edge of PVC sheet using fastening plates or metal battens centered within seam, and mechanically fasten PVC sheet to roof deck.
- G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
  - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
  - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
  - 3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.
- H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

#### 3.8 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

# 3.9 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

# 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
  - 1. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of base flashing.
  - 2. Flood each area for 24 hours.
  - 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

# 3.11 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

#### 3.12 **ROOFING INSTALLER'S WARRANTY**

- WHEREAS \_\_\_\_\_\_ of \_\_\_\_\_, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the Α following project:
  - 1. Owner:
  - 2. Address:
  - Building Name/Type: 3.
  - 4. Address:
  - 5. Area of Work:
  - Acceptance Date: \_\_\_\_\_. 6.
  - Warranty Period: 7.
  - Expiration Date: \_\_\_\_\_\_. 8.
- AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a B. subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein C. set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
  - Specifically excluded from this Warranty are damages to work and other parts of the 1. building, and to building contents, caused by:
    - a. lightning;
    - peak gust wind speed exceeding 130 mph; b.
    - fire: c.
    - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - faulty construction of parapet walls, copings, chimneys, skylights, vents, e. equipment supports, and other edge conditions and penetrations of the work;
    - f. vapor condensation on bottom of roofing; and
    - activity on roofing by others, including construction contractors, maintenance g. personnel, other persons, and animals, whether authorized or unauthorized by Owner.

- 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
- 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
- 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
- 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
- 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
- 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.
- E. IN WITNESS THEREOF, this instrument has been duly executed this \_\_\_\_\_ day of
  - 1. Authorized Signature: \_\_\_\_\_\_.
  - 2. Name: \_\_\_\_\_\_.
  - 3. Title: \_\_\_\_\_\_.

#### END OF SECTION 075419

# SECTION 076200 - SHEET METAL FLASHING AND TRIM

# PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Formed Products:
    - a. Formed roof drainage sheet metal fabrications.
    - b. Formed low-slope roof sheet metal fabrications.
    - c. Flashing for window and door openings.
    - d. Gutters and downspouts.
    - e. Roof Vents.
    - f. Sheet metal (SM) coping, flashing, fascia, and continuous cleats.
    - g. Thru-wall scupper conductor head and overflow scupper.
- B. Related Sections:
  - 1. Division 06 Section "Rough Carpentry" for wood nailers, curbs, and blocking.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
  - Wind Zone 1: For velocity pressures of 21 to 30 lbf/sq. ft. (1.00 to 1.44 kPa): 60-lbf/sq. ft. (2.87-kPa) perimeter uplift force, 90-lbf/sq. ft. (4.31-kPa) corner uplift force, and 30lbf/sq. ft. (1.44-kPa) outward force.
- C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
  - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
  - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
  - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  - 4. Details of termination points and assemblies, including fixed points.
  - 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
  - 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
  - 7. Details of special conditions.
  - 8. Details of connections to adjoining work.
  - 9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.
- D. Warranty: Sample of special warranty.

# 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

# 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

C. Protect adjacent construction from damage, including penetration of roof membranes or weather barriers.

## 1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

# 2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Zinc-Coated (Galvanized) Steel Sheet (concealed cleats): ASTM A 653/A 653M, G90 coating designation; structural quality; 22 gauge.
- C. Pre-painted, Metallic-Coated Steel Sheet (roof flashings & gutter): ASTM A6531 A653M G90 coating designation; 24 gauge. Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.
  - 1. High-Performance Organic Finish: Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Fluoropolymer 3-Coat System: Manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with physical properties and coating performance requirements of AAMA 2605, except as modified below:
    - b. Humidity Resistance: 1000 hours.
    - c. Salt-Spray Reisistance: 1000 hours.
  - Roof edge flashings, collector boxes and downspouts to match custom colors as follows:
    a. Color: Match adjacent metal wall panel.
  - 3. Window and door flashings to match color of aluminum storefront framing.

- 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- D. Stainless-Steel Sheet: ASTM A167, Grade 2D, Type 304, soft temper, min. 0.025-inch thick smooth finish. No. 2D dull; cold rolled finish.
- E. Lead Sheet: ASTM B767 B 749, type L51121.

# 2.2 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- B. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slipresisting, polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 1. Thermal Stability: Stable after testing at 240 deg F ; ASTM D 1970.
  - 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F ; ASTM D 1970.
  - 3. Products: Subject to compliance with requirements, provide an approved product from the same manufacturer that furnishes the weather barrier.
- C. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

### 2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
  - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
    - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  - 2. Fasteners for Pre-painted, Metallic-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

- C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

# 2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
  - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  - 2. Obtain field measurements for accurate fit before shop fabrication.
  - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
  - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

- G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

### 2.5 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
  - 1. Fabricate from the following materials: Pre-painted, Metallic-Coated Steel Sheet.
- B. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
  - 1. Pre-painted, Metallic-Coated Steel Sheet.

## 2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof-Edge Flashing : Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections.
  - 1. Joint Style: Lap 6-inches with two lines of butyl sealant concealed in lap.
  - 2. Fabricate from the following materials:
    - a. Pre-painted, Metallic-Coated Steel Sheet.
- B. Copings: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
  - 1. Coping Profile: As indicated on drawings.
  - 2. Joint Style: Standing Seams.
  - 3. Fabricate from the following materials:
    - a. Pre-painted, Metallic-Coated Steel Sheet.
- C. Counterflashing: Fabricate from the following materials:1. Pre-painted, Metallic-Coated Steel Sheet.

### 2.7 WALL SHEET METAL FABRICATIONS

- A. Wall Flashings: Fabricate from the following materials:
  - 1. Pre-painted, Metallic-Coated Steel Sheet.

# PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as indicated on Drawings or as indicated below.
- B. Felt Underlayment: Install felt underlayment with staples. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

### 3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  - 3. Anchor continuous cleats to meet performance requirements article.
  - 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
  - 5. Install sealant tape where indicated.
  - 6. Torch cutting of sheet metal flashing and trim is not permitted.
  - 7. <u>All flashing shall extend a minimum of 4"beyond where it becomes concealed. It shall be greater than 4" where specifically dimensioned on the drawings.</u>

- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
  - 1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate through wood sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws. For metal decking, penetrate through not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints as required for watertight construction.

# 3.4 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.
  - 1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
  - 2. Provide elbows at base of downspout to direct water away from building.
  - 3. Connect downspouts to underground drainage system indicated.
  - 4. Downspout Size: 3-inches by 4-inches.
- C. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch below scupper discharge.

# 3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at 16-inch (400mm) centers.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 6 inches with two lines of butyl inside of lap.

## 3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

## 3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

# 3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

## PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes: 1. Roof hatches.
- B. Related Sections:
  - 1. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
  - 2. Section 079500 " Expansion Control" for manufactured roof expansion-joint covers.

### 1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant-and field-assembled work.

# 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

## 1.6 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

## PART 2 - PRODUCTS

### 2.1 METAL MATERIALS

- A. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
  - 1. Mill Finish: As manufactured.
- B. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

# 2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.
- C. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
  - 1. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- D. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- F. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

G. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.3 ROOF HATCH

- A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, and integrally formed deck-mounting flange at perimeter bottom.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AES Industries, Inc.
    - b. Babcock-Davis.
    - c. Bilco Company (The).
    - d. Bristolite Skylights.
    - e. Custom Solution Roof and Metal Products.
    - f. Dur-Red Products.
    - g. Hi Pro International, Inc.
    - h. J. L. Industries, Inc.
    - i. Metallic Products Corp.
    - j. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
    - k. Naturalite Skylight Systems; Vistawall Group (The).
    - l. Nystrom.
    - m. O'Keeffe's Inc.
    - n. Pate Company (The).
    - o. Precision Ladders, LLC.
- B. Type and Size: Single-leaf lid, 30 by 36 inches.
- C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.
- D. Hatch Material: Aluminum sheet, 0.090 inch thick.
  - 1. Finish: Mill.
- E. Construction:
  - 1. Fabricate curbs to minimum height of 12 inches unless otherwise indicated.
  - 2. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.
- F. Hardware: Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

# 3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
  - 1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
  - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
  - 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

## 3.3 REPAIR AND CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.
- B. Clean off excess sealants.
- C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

# ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON

END OF SECTION 077200

## SECTION 078413 - PENETRATION FIRESTOPPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through fireresistance-rated constructions, including both empty openings and openings containing penetrating items.
- B. Related Sections include the following:
  - 1. Division 21 Sections specifying fire-suppression piping penetrations.
  - 2. Division 22 and 23 Sections specifying duct and piping penetrations.
  - 3. Division 26 and 28 Sections specifying cable and conduit penetrations.

### 1.3 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
  - 1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers and smoke barriers.
  - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814
  - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
  - 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
    - a. Penetrations located outside wall cavities.

- b. Penetrations located outside fire-resistance-rated shaft enclosures.
- 3. L-Rated Systems: Where through-penetration firestop systems are indicated in smoke barriers, provide through-penetration firestop systems with L-ratings indicated of not more than 3.0 cfm/sq. ft (0.01524cu. m/s x sq. m) at both ambient temperatures and 400 deg F (204 deg C).
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
  - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
  - 2. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
  - 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
  - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
  - 2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
  - 1. Types of penetrating items.
  - 2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
  - 3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

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- D. Qualification Data: For Installer.
- E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

# 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Installation Responsibility: Assign installation of through-penetration firestop systems and fireresistive joint systems in Project to a single qualified installer.
- C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.
- D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
  - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
  - 2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
    - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
      - 1) UL in its "Fire Resistance Directory."
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

# 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and

inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

## 1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

# PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application in the Through-Penetration Firestop System Schedule that are produced by one of the following manufacturers:
  - 1. A/D Fire Protection Systems Inc.
  - 2. Grace, W. R. & Co. Conn.
  - 3. Hilti, Inc.
  - 4. Johns Manville.
  - 5. Nelson Firestop Products.
  - 6. NUCO Inc.
  - 7. RectorSeal Corporation (The).
  - 8. Specified Technologies Inc.

- 9. 3M; Fire Protection Products Division.
- 10. Tremco; Sealant/Weatherproofing Division.
- 11. USG Corporation.

# 2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
  - 1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-/rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - c. Fire-rated form board.
    - d. Fillers for sealants.
  - 2. Temporary forming materials.
  - 3. Substrate primers.
  - 4. Collars.
  - 5. Steel sleeves.

# 2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.
- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.
- J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
  - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
  - 3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

# 2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

# PART 3 - EXECUTION

# 3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

# 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

# 3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

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

### 3.4 IDENTIFICATION

- A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
  - 1. The words "Warning Through-Penetration Firestop System Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Through-penetration firestop system designation of applicable testing and inspecting agency.
  - 4. Date of installation.
  - 5. Through-penetration firestop system manufacturer's name.
  - 6. Installer's name.

# 3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.
- B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

## 3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

### 3.7 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Where OPL-classified systems are indicated, they refer to alpha-numeric design numbers in OPL's "Directory of Listed Building Products, Materials, & Assemblies."
- C. Where ITS-listed systems are indicated, they refer to design numbers listed in ITS's "Directory of Listed Products," "Firestop Systems" Section.
- D. Firestop Systems with No Penetrating Items:
  - 1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, W-J-, W-L-, 0001-0999.
  - 2. Type of Fill Materials: One or more of the following:
    - a. Latex sealant.
    - b. Silicone sealant.
    - c. Intumescent putty.
    - d. Mortar.
- E. Firestop Systems for Metallic Pipes, Conduit, or Tubing:
  - 1. Available UL-Classified Systems: C-AJ-, C-BJ-, C-BK-, F-A-, F-B-, F-C-, W-J-, W-K-, W-L-, 1001-1999.
  - 2. Type of Fill Materials: One or more of the following:
    - a. Latex sealant.
    - b. Silicone sealant.
    - c. Intumescent putty.
    - d. Mortar.
- F. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:
  - 1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, F-B-, F-C-, W-J-, W-L-, 2001-2999.
  - 2. Type of Fill Materials: One or more of the following:
    - a. Latex sealant.
    - b. Silicone sealant.
    - c. Intumescent putty.
    - d. Intumescent wrap strips.
    - e. Firestop device.
- G. Firestop Systems for Electrical Cables:
  - 1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, F-B-, F-C-, W-J-, W-L-, 3001-3999.
  - 2. Type of Fill Materials: One or more of the following:

- a. Latex sealant.
- b. Silicone sealant.
- c. Intumescent putty.
- d. Silicone foam.
- e. Pillows/bags.
- H. Firestop Systems for Cable Trays:
  - 1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, F-B-, F-C-, W-J-, W-K-, W-L-, 4001-4999.
  - 2. Type of Fill Materials: One or more of the following:
    - a. Latex sealant.
    - b. Intumescent putty.
    - c. Silicone foam.
    - d. Pillows/bags.
    - e. Mortar.
- I. Firestop Systems for Insulated Pipes:
  - 1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, F-C-, W-J-, W-L-, 5001-5999.
  - 2. Type of Fill Materials: One or more of the following:
    - a. Latex sealant.
    - b. Intumescent putty.
    - c. Silicone foam.
    - d. Intumescent wrap strips.
- J. Firestop Systems for Miscellaneous Electrical Penetrants:
  - 1. Available UL-Classified Systems: C-AJ-, F-A-, W-L-, 6001-6999.
  - 2. Type of Fill Materials: One or more of the following:
    - a. Latex sealant.
    - b. Intumescent putty.
    - c. Mortar.
- K. Firestop Systems for Miscellaneous Mechanical Penetrants:
  - 1. Available UL-Classified Systems: C-AJ-, F-C-, W-J-, W-L-, 7001-7999.
  - 2. Type of Fill Materials: One or both of the following:
    - a. Latex sealant.
    - b. Mortar.
- L. Firestop Systems for Groupings of Penetrants:
  - 1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, F-C-, W-J-, W-L-, 8001-8999.
  - 2. Type of Fill Materials: One or more of the following:

- a. Latex sealant.
- b. Mortar.
- Intumescent wrap strips. c.
- d.
- Firestop device. Intumescent composite sheet. e.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Silicone joint sealants.
  - 2. Mildew-resistant joint sealants.
  - 3. Latex joint sealants.
- B. Related Requirements:
  - 1. Section 079500 "Expansion Control."

# 1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

# 1.5 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by jointsealant manufacturer or are below 40 deg F (5 deg C).
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.6 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

## 2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

## 2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Uses T and NT.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Dow Corning Corporation; 799
    - b. GE Silicones; UltraGlaze SSG4000.
    - c. GE Silicones; UltraGlaze SSG4000AC.
    - d. Polymeric Systems Inc.; PSI-631.
    - e. Schnee-Morehead, Inc.; SM5731 Poly-Glaze Plus.
    - f. Tremco; Proglaze SG.
    - g. Tremco; Spectrem 2.
    - h. Tremco; Tremsil 600.

### 2.3 MILDEW-RESISTANT JOINT SEALANTS

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

# 2.4 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 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. BASF Corporation-Construction Systems; Sonolac
    - b. May National Associates, Inc.; a subsidiary of Sika Corporation; Bondaflex 600 or Bondaflex Sil-A 700
    - c. Pecora Corporation; AC-20
    - d. Sherwin-Williams Company (The); 850A or 950A or Powerhouse
    - e. Tremco Incorporated; Tremflex 834

# 2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.6 MISCELLANEOUS MATERIALS

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

# PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

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# 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  - 1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

- 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
  - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
- 3. Inspect tested joints and report on the following:
  - a. Whether sealants filled joint cavities and are free of voids.
  - b. Whether sealant dimensions and configurations comply with specified requirements.
  - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
- 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
- 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

# 3.5 CLEANING

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

# 3.6 **PROTECTION**

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

## 3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
  - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Construction joints in cast-in-place concrete.
    - b. Joints between plant-precast architectural concrete units.
    - c. Control and expansion joints in unit masonry.
    - d. Joints between metal panels.
    - e. Joints between different materials listed above.
    - f. Perimeter joints between materials listed above and frames of doors and windows.
    - g. Control and expansion joints in overhead surfaces.
    - h. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
  - 1. Joint Locations:
    - a. Control joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Acrylic latex.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.

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- 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Concealed mastics.
  - 1. Joint Locations:
    - a. Aluminum thresholds.
    - b. Sill plates.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Butyl-rubber based.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

# END OF SECTION 079200

SECTION 079500 - EXPANSION CONTROL

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior expansion control systems.
  - 2. Exterior expansion control systems.
- B. Related Requirements:
  - 1. Section 075419 "Polyvinyl-chloride (PVC) Roofing."
  - 2. Division 07 Section "Joint Sealants" for liquid-applied joint sealants and for elastomeric sealants without metal frames.

### 1.3 ACTION SUBMITTALS

- A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- B. Product Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
  - 1. Manufacturer and model number for each expansion control system.
  - 2. Expansion control system location cross-referenced to Drawings.
  - 3. Nominal joint width.
  - 4. Movement capability.
  - 5. Classification as thermal or seismic.
  - 6. Materials, colors, and finishes.
  - 7. Product options.
  - 8. Fire-resistance ratings.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
  - 1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
  - 2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.
- B. Coordination: Coordinate installation of exterior wall expansion control systems with roof expansion control systems including factory-fabricated units at transitions between roof expansion joints and exterior wall expansion joints to ensure that wall transitions are watertight. Roof expansion joint assemblies are specified in Division 07 Sections.

# 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide expansion control systems with fire barriers identical to those of systems tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Hose Stream Test: Wall-to-wall and wall-to-ceiling systems shall be subjected to hose stream testing.
- B. Seismic Performance: Expansion control systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
  - 2. Component Importance Factor is as indicated on the structural drawings.

# 2.3 INTERIOR EXPANSION CONTROL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products from manufacturers as indicated in the paragraphs below, or comparable products by one of the following manufacturers:
  - 1. MM Systems
  - 2. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
  - 3. Balco, Inc.
  - 4. Construction Specialties, Inc.
  - 5. Nystrom, Inc.

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- 6. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- C. Wall-to-Wall Joint Systems (Interior):
  - 1. Basis-of-Design Product: C/S SC-400
  - 2. Type: Elastomeric seal.
    - a. Seal Material: Santoprene.
      - 1) Color: As selected by Architect from manufacturer's full range.
- D. Ceiling-to-Ceiling Joint Systems in Acoustic Panel Ceilings (Interior):
  - 1. Basis-of-Design Product: MM Systems; Model DX-400.
  - 2. Type: Suspended.
    - a. Seal Material: Santoprene.
      - 1) Color: As selected by Architect from manufacturer's full range.
- E. Ceiling-to-Ceiling Joint Systems in GWB Ceilings (Interior):
  - 1. Basis-of-Design Product: MM Systems; Model FX-K-4-1.
  - 2. Type: Flush with ceiling surface.
    - a. Exposed Metal: Aluminum.
      - 1) Finish: Paint to match ceiling.

# 2.4 EXTERIOR WALL EXPANSION CONTROL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or a comparable product by one of the following:
  - 1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
  - 2. Balco, Inc.
  - 3. Construction Specialties, Inc.
  - 4. Nystrom, Inc.
  - 5. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- C. Wall-to-Wall:
  - 1. Basis-of-Design Product: MM Systems; VSS-200
  - 2. Type: Flat seal.
- a. Seal Material: Santoprene or Silicone.
  - 1) Color: As selected by Architect from manufacturer's full range.
- b. Secondary Seal: Manufacturer's standard extruded-elastomeric seal designed to prevent water and moisture infiltration.
- D. Roof-to-Wall:
  - 1. Basis-of-Design Product: MM Systems; ERFL-400
  - 2. Type: straight-flange.
    - a. Exposed Metal: Aluminum.
  - 3. Secondary Seal: Manufacturer's standard extruded-elastomeric seal designed to prevent water and moisture infiltration.
- E. Roof-to-Roof:
  - 1. Basis-of-Design Product: MM Systems; RXH-4-1
  - 2. Type: Curb mounted.
    - a. Exposed Metal: Aluminum.
  - 3. Secondary Seal: Manufacturer's standard extruded-elastomeric seal designed to prevent water and moisture infiltration.

#### 2.5 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard moisture barrier consisting of a continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary cover.
  - 1. Drain-Tube Assemblies: Equip moisture barrier with drain tubes and seals to direct collected moisture to exterior-wall expansion control system.

## 2.6 MATERIALS

- A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.
  - 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304 for plates, sheet, and strips.
  - 1. Remove tool and die marks and stretch lines or blend into finish.
- C. Brass: ASTM B 36/B 36M, UNS Alloy C26000 for half hard sheet and coil.

- D. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.
- E. Compression Seals: ASTM E 1612; preformed elastomeric extrusions having an internal baffle system and designed to function under compression.
- F. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.
- G. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.
- H. Moisture Barrier: Manufacturers standard flexible elastomeric material.
- I. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.
- J. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

### 2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.8 ALUMINUM FINISHES

A. Clear anodized finish: AAM611, AA-M12C22A41, Class I, 0.018mm or thicker.

# PART 3 - EXECUTION

# 3.1 EXAMINATION

- A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to expansion control system manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.
- C. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

### 3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.
  - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
  - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper expansion control system installation and performance.
  - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
  - 4. Repair or grout block-out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
  - 5. Install frames in continuous contact with adjacent surfaces.
    - a. Shimming is not permitted.
  - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
- C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
  - 1. Provide in continuous lengths for straight sections.
  - 2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
  - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.
- E. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.

- 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- F. Moisture Barrier: Provide at all exterior joints and where indicated on Drawings. Provide drainage fittings at a maximum of 50 feet or where indicated on Drawings.

### 3.4 **PROTECTION**

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION 079500

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
  - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

### 1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

#### 1.4 COORDINATION

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

### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of anchorages, joints, field splices, and connections.
  - 7. Details of accessories.

- 8. Details of moldings, removable stops, and glazing.
- 9. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

### 1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

## PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amweld International, LLC.
  - 2. Apex Industries, Inc.
  - 3. Ceco Door; ASSA ABLOY.
  - 4. Commercial Door & Hardware Inc.
  - 5. Concept Frames, Inc.
  - 6. Curries Company; ASSA ABLOY.
  - 7. Custom Metal Products.
  - 8. Daybar Industries, Ltd.
  - 9. DE LA FONTAINE.
  - 10. Deansteel Manufacturing Company, Inc.
  - 11. DKS Steel Door & Frame Systems, Inc.
  - 12. Door Components, Inc.
  - 13. Fleming Door Products Ltd.; Assa Abloy Group Company.

- 14. Gensteel Doors, Inc.
- 15. Greensteel Industries, Ltd.
- 16. HMF Express, LLC.
- 17. Hollow Metal Inc.
- 18. Hollow Metal Xpress.
- 19. J/R Metal Frames Manufacturing, Inc.
- 20. Karpen Steel Custom Doors & Frames.
- 21. L.I.F. Industries, Inc.
- 22. LaForce, Inc.
- 23. Megamet Industries, Inc.
- 24. Mesker Door Inc.
- 25. Michbi Doors Inc.
- 26. MPI Group, LLC (The).
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

# 2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

## 2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.
  - 1. Physical Performance: Level B according to SDI A250.4.
  - 2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches (44.5 mm).
    - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
    - d. Edge Construction: Model 2, Seamless.

- e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
- 3. Frames:
  - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
  - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
  - c. Construction: Full profile welded.
  - d. Frame width: 1-inch unless otherwise indicated or otherwise required by rated frame assembly.
- 4. Exposed Finish: Prime.

### 2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.
  - 1. Physical Performance: Level A according to SDI A250.4.
  - 2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches (44.5 mm.)
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
    - d. Edge Construction: Model 2, Seamless.
    - e. Core: Polyisocyanurate.
      - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.
  - 3. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
    - b. Construction: Full profile welded.
  - 4. Exposed Finish: Prime.

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## 2.5 BORROWED LITES

- A. Hollow-metal frames of uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm)
- B. Construction: Full profile welded.

### 2.6 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

#### 2.7 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
  - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
  - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
  - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-(9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
  - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
  - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

## 2.8 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

- 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Section 088000 "Glazing."
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

### 2.9 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
  - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
  - 2. Fire Door Cores: As required to provide fire-protection ratings indicated.
  - 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
  - 4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
  - 5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
  - 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
  - 7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19

mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  - 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
      - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
      - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
      - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
    - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
      - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
      - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
      - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
    - c. Compression Type: Not less than two anchors in each frame.
    - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
  - 6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
  - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
  - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollowmetal work.
  - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  - 4. Provide loose stops and moldings on inside of hollow-metal work.
  - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

#### 2.10 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

#### 2.11 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

#### PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

## 3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-rated openings, install frames according to NFPA 80.
    - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - c. Install frames with removable stops located on secure side of opening.
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

- 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
- 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
- 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
- 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
- 7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
- 8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
  - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
  - 1. Non-Fire-Rated Steel Doors:
    - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
    - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
    - c. At Bottom of Door: 3/4 inch (19.1 mm) plus or minus 1/32 inch (0.8 mm).
    - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
  - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollowmetal manufacturer's written instructions.
  - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

### 3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

#### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Solid-core doors with wood-veneer faces.
  - 2. Factory finishing flush wood doors.
- B. Related Sections:
  - 1. Division 08 Section "Glazing" for glass view panels in flush wood doors.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers and trim for openings.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
  - 1. Indicate dimensions and locations of mortises and holes for hardware.
  - 2. Indicate dimensions and locations of cutouts.
  - 3. Indicate requirements for veneer matching.
  - 4. Indicate doors to be factory finished and finish requirements.
- C. Samples for Initial Selection: For factory-finished doors.
- D. Warranty: Sample of special warranty.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors from single manufacturer.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

#### 1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
    - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
  - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Algoma Hardwoods, Inc.
  - 2. Ampco, Inc.
  - 3. Buell Door Company Inc.
  - 4. Chappell Door Co.
  - 5. Eagle Plywood & Door Manufacturing, Inc.
  - 6. Eggers Industries.
  - 7. Graham; an Assa Abloy Group company.
  - 8. Haley Brothers, Inc.

- 9. Ideal Architectural Doors & Plywood.
- 10. Ipik Door Company.
- 11. Lambton Doors.
- 12. Lyndon Doors.
- 13. Marshfield Door Systems, Inc.
- 14. Oshkosh Architectural Door Company.
- 15. Vancouver Door Company.
- 16. VT Industries Inc.

### 2.2 DOOR CONSTRUCTION, GENERAL

- A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
- B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- C. Particleboard-Core Doors:
  - 1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2.
  - 2. Blocking: Provide wood blocking in particleboard-core doors as follows:
    - a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
    - b. 5-inch (125-mm) bottom-rail blocking, in doors indicated to have kick, mop, or armor plates.
    - c. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

## 2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
  - 1. Grade: Premium, with Grade A faces.
  - 2. Species: Maple
  - 3. Cut: Plain sliced (flat sliced).
  - 4. Match between Veneer Leaves: Slip match.
  - 5. Assembly of Veneer Leaves on Door Faces: Running match.
  - 6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
  - 7. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
  - 8. Exposed Vertical and Top Edges: Same species as faces.
  - 9. Core: Particleboard
  - 10. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.
  - 11. WDMA I.S.1-A Performance Grade: Heavy Duty.

### 2.4 LOUVERS AND LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
  - 1. Wood Species: Species compatible with door faces.
  - 2. Profile: Manufacturer's standard shape.
- B. Metal Louvers:
  - 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. Air Louvers Inc.
    - b. Anemostat; a Mestek company.
    - c. Hiawatha Incorporated.
    - d. L & L Louvers, Inc.
    - e. LL Building Products, Inc.; a division of GAF Materials Corporation.
    - f. Louvers & Dampers, Inc.; a Mestek company.
    - g. McGill Architectural Products.
  - 2. Blade Type: Vision-proof, inverted V or Vision-proof, inverted Y.
  - 3. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.

#### 2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
  - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Cut and trim openings through doors in factory.
  - 1. Light Openings: Trim openings with moldings of material and profile indicated.
  - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."
  - 3. Louvers: Factory install louvers in prepared openings.

### 2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory.
- C. Transparent Finish:
  - 1. Grade: Custom.
  - 2. Finish: WDMA TR-6 catalyzed polyurethane.
  - 3. Staining: As selected by Architect from manufacturer's full range.
  - 4. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
  - 5. Sheen: Satin.

### PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
  - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  - 1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.

- 2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

## 3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

### SECTION 083113 - ACCESS DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Access doors and frames for walls and ceilings.
    - a. Access to mechanical and electrical components
- B. Related Sections include the following:
  - 1. Division 7 "Thermal Insulation" for rigid insulation adhered to bottom side of floor access doors.
  - 2. Division 08 Section "Door Hardware" for mortise or rim cylinder locks and master keying.
  - 3. Division 23 Section "Air Duct Accessories" for heating and air-conditioning duct access doors.

# 1.3 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- C. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation. In no cases shall access doors be smaller than 12" x 16".

#### 1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.

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### 1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

## PART 2 - PRODUCTS

## 2.1 STEEL MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
  - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
  - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Steel Sheet: Electrolytic zinc-coated, ASTM A 591/A 591M with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
  - 2. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.
- D. Drywall Beads: Edge trim formed from 0.0299-inch (0.76-mm) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

#### 2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Acudor Products, Inc.
  - 2. Babcock-Davis; A Cierra Products Co.
  - 3. Bar-Co, Inc. Div.; Alfab, Inc.
  - 4. Cendrex Inc.
  - 5. Dur-Red Products.
  - 6. Elmdor/Stoneman; Div. of Acorn Engineering Co.
  - 7. Jensen Industries.
  - 8. J. L. Industries, Inc.
  - 9. Karp Associates, Inc.
  - 10. Larsen's Manufacturing Company.
  - 11. MIFAB, Inc.

- 12. Milcor Inc.
- 13. Nystrom, Inc.
- 14. Williams Bros. Corporation of America (The).
- B. Flush Access Doors and Trimless Frames: Fabricated from steel sheet.
  - 1. Locations: Wall and ceiling surfaces.
  - 2. Door: Minimum 0.060-inch- (1.5-mm-) thick sheet metal, set flush with surrounding finish surfaces.
  - 3. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with drywall bead flange.
  - 4. Hinges: Continuous piano.
  - 5. Latch:
    - a. Ceilings: cam latch operated by screwdriver.
    - b. Walls: Keyed lock to District standard with Schlage cylinder heavy-duty C and D series, 6-pin keyway.

### 2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
  - 1. For trimless frames with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
  - 2. Provide mounting holes in frames for attachment of units to metal or wood framing.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

## PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

- D. Glue 6" of rigid board insulation to underside of door to maintain thermal barrier.
- 3.2 ADJUSTING AND CLEANING
  - A. Adjust doors and hardware after installation for proper operation.
  - B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

## SECTION 083313 - COILING COUNTER DOORS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Counter doors.
  - 2. Fire-rated counter doors (Fire Shutter).
- B. Related Requirements:
  - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of coiling counter door and accessory.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 2. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
  - 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.
  - 1. Temperature-Rise Limit: At exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
  - 2. Smoke Control: In corridors and smoke barriers, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. (0.01524 cu. m/s x sq. m) of door opening at 0.10-inch wg (24.9 Pa) for both ambient and elevated temperature tests.
- C. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
- D. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

# PART 2 - PRODUCTS

### 2.1 COUNTER DOOR ASSEMBLY

- A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats with Integral Frame and Sill.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Cornell Model ESC20 (non-rated) or comparable product by one of the following:
    - a. McKeon Rolling Steel Door Company, Inc.
    - b. Overhead Door Corporation.
    - c. Raynor.
- B. Operation Cycles: Door components and operators capable of operating for not less than 10,000.
- C. Door Curtain Material: 22 Gauge Stainless steel with #4 Finish.
- D. Door Curtain Slats: Flat profile slats of 1-1/4-inch center-to-center height.
- E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated stainless steeland finished to match door.
- F. Curtain Jamb Guides: Stainless steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- G. Hood: Match curtain material and finish.

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- 1. Mounting: As shown on Drawings.
- H. Integral Frame, Hood, and Fascia: Stainless steel.
  - 1. Mounting: shown on Drawings.
- I. Sill Configuration: Integral metal sill.
- J. Locking Devices: Equip door with slide bolt for padlock.
- K. Manual Door Operator: Push-up operation.
- L. Curtain Accessories: Equip door with push/pull handles.

### 2.2 FIRE-RATED COUNTER DOOR ASSEMBLY (FIRE SHUTTER)

- A. Fire-Rated Counter Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:
    - a. Rolling counter fire shutters: FireCurtain SELECT as manufactured by Raynor (P.O. Box 448, 1101 East River Rd., Dixon, IL 61021-0448 (800-472-9667; www.raynor.com).
    - b. Model: UPI, Built-in frame, Under Lintel between jamb mount by Raynor
- B. Fire Rating: 1-1/2 hours.
- C. Door Curtain Material: 22 Gauge Stainless steel.
- D. Door Curtain Slats: The rolling counter fire shutter curtain shall be comprised of interlocking, flat type steel slats.
- E. Curtain Jamb Guides: Guides shall be provided in the same material and finished as the shutter curtain, and be fitted with removable curtain stop.
- F. Endlocks: Lateral movement of the slats to be contained by means of zinc-plated stamped steel endlocks fastened to the slat.
- G. Bottom Bar and Seal: Bottom bar shall be roll-formed tubular stainless steel. The bottom bar shall include  $\frac{1}{4}$ " (6.3 mm) thick protective strip to cushion impact of bottom bar on countertop.
- H. Jamb Construction: Rolling counter fire shutter shall be mounted to non-masonry Jambs: as optionally-provided for jambs consisting of drywall or plaster (fasteners included).
- I. Integral Frame, Hood, and Fascia: Stainless steel.
  - 1. Mounting: Under lintel and between jambs, as shown on Drawings.

- J. Sill Configuration: Integral UL 1-1/2-hour rated pressure-laminate counter top.
  - 1. Approved laminate manufacturers: Formica, Wilsonart, and Nevamar.
  - 2. Color: By Architect from standard manufacturer's range.
- K. Power operation: Tube Motor: as optionally-provided by means of a Raynor FireEclipse <sup>TM</sup> tube motor type electric operator. Tube motor shall be concealed inside the barrel assembly and bracket cover.
- L. Counterbalance System:
  - 1. Headplates: Mounting brackets shall be made from 10 gauge galvanized steel plate and attached to the wall and guide.
  - Barrel: The barrel shall be made from a minimum 4 <sup>1</sup>/<sub>2</sub>" (114.3 mm) O.D. x .120" (3.1 mm) wall structural steel pipe. Deflection of pipe under full load shall not exceed .03" (.8 mm) per foot of span.
  - 3. Counterbalance: Tube Motor Operation.
- M. Door Finish:
  - 1. Stainless-Steel Finish: No. 4 (polished directional satin).
  - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.
- N. Release Type: Automatic closing of rolling counter fire shutters under fire conditions to be initiated by Building fire-detection, smoke-detection, and -alarm systems.

## 2.3 MATERIALS, GENERAL

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.

# 2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate coiling counter-door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  - 1. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
  - 2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.
  - 1. Removable Posts and Jamb Guides: Manufacturer's standard.

### 2.5 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  - 1. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
- B. Integral Frame, Hood, and Fascia: Welded stainless-steel sheet metal.

## 2.6 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  - 1. Lock Cylinders: Cylinders standard with manufacturer and keyed to building keying system.
  - 2. Keys: Three for each cylinder.
- C. Chain Lock Keeper: Suitable for padlock.
- D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## 2.7 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Astragal: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
- D. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches (2130 mm) high.
- E. Poll Hooks: Provide pole hooks and poles for doors more than 84 inches (2130 mm) high.
- F. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and

reset release mechanism. Automatic-closing device shall be designed for activation by the following:

1. Building fire-detection, smoke-detection, and -alarm systems.

## 2.8 COUNTER DOOR ACCESSORIES

- A. Integral Metal Sill: Fabricate sills as integral part of frame assembly of Type 304 stainless steel in manufacturer's standard thickness with No. 4 finish.
- B. Fire-Rated, Laminate Counter: Fire-door manufacturer's high-pressure decorative laminatecovered countertop, UL or ITS tested and labeled for 1-1/2-hour fire rating for approved use with fire-door assembly.

### 2.9 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.10 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf (111 N).

## 2.11 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  - 1. Manufacturer: Basis of Design is Raynor (Tube Motor Operator).
  - 2. Comply with NFPA 70.
  - 3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

- C. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
  - 1. Electrical Characteristics:
    - a. Phase: Single phase.
    - b. Volts: 115.
    - c. Hertz: 60.
  - 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
  - 3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
- D. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For fire-rated doors, activation delays closing.
  - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
    - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.
  - 2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    - a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
  - 3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal mounted to bottom bar. Contact with sensor activates device.
- E. Control Station: Three-button control station in fixed location with momentary-contact pushbutton controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
  - 1. Type: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).
- G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency

manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

### PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Fire-Rated Doors: Install according to NFPA 80.
- C. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.
- D. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer. Adjust seals to provide tight fit around entire perimeter.

### 3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 083313

## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Exterior and interior storefront framing.
  - 2. Storefront framing for window walls.
  - 3. Storefront framing for punched openings.
  - 4. Exterior and interior manual-swing entrance doors and door-frame units.

# 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
  - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  - 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminumframed entrances and storefronts, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.
  - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
  - 1. Basis for Certification: NFRC-certified energy performance values for each aluminumframed entrance and storefront.
- C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing agency.
- D. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranties: For special warranties.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - d. Water penetration through fixed glazing and framing areas.
    - e. Failure of operating components.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
- 2. Failure also includes the following:
  - a. Thermal stresses transferring to building structure.
  - b. Glass breakage.
  - c. Noise or vibration created by wind and thermal and structural movements.
  - d. Loosening or weakening of fasteners, attachments, and other components.
  - e. Failure of operating units.
- C. Structural Loads:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Seismic Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
  - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
  - 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
    - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
- E. Structural: Test according to ASTM E 330 as follows:
  - 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
  - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
  - 1. Fixed Framing and Glass Area:
    - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
  - 2. Entrance Doors:

- a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
  - 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- H. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- I. Energy Performance: Certify and label energy performance according to NFRC as follows:
  - 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) as determined according to NFRC 100.
  - 2. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.
- J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

# 2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Kawneer North America; an Alcoa company as indicated in product requirements or comparable product by one of the following::
  - 1. EFCO Corporation.
  - 2. United States Aluminum.
  - 3. Vistawall Architectural Products.
  - 4. YKK AP America Inc.
- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

### 2.3 FRAMING

A. A.Basis-of-Design Product: Subject to compliance with requirements, provide products by Kawneer North America; an Alcoa company; Trifab® 451UT:

- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Construction: Thermally broken.
  - 2. Glazing System: Retained mechanically with gaskets on four sides.
  - 3. Glazing Plane: Front.
  - 4. Finish: Anodized finish from manufacturer's standard colors.
  - 5. Fabrication Method: Field-fabricated stick system.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Materials:
  - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
    - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
    - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
    - d. Structural Profiles: ASTM B 308/B 308M.
  - 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
    - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
    - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
    - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

# 2.4 NON THERMAL FRAMING (Interior Framing)

- A. Basis of Design Product: Subject to compliance with requirements, provide Kawneer North America; an Alcoa company, 451 Framing System:
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Construction: Nonthermal.
  - 2. Glazing System: Retained mechanically with gaskets on four sides.
  - 3. Glazing Plane: Front.
  - 4. Finish: Anodized finish from manufacturer's standard colors.
  - 5. Fabrication Method: Field-fabricated stick system.

- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Materials:
  - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
    - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
    - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
    - d. Structural Profiles: ASTM B 308/B 308M.

## 2.5 THERMALLY BROKEN ENTRANCE DOOR SYSTEMS (Exterior Doors)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Kawneer North America; an Alcoa company; Insulclad 560 as indicated in product requirements or comparable product by one of the following:
- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
  - 1. Door Construction: 2- to 2-1/4-inch (50.8- to 57.2-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
    - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
  - 2. Door Design: Wide stile; 5-inch (127-mm) nominal width.
  - 3. Bottom Rail: As indicated on Drawings.
  - 4. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
    - a. Provide nonremovable glazing stops on outside of door.

#### 2.6 NONTHERMAL ENTRANCE DOOR SYSTEMS (Interior Doors)

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
  - 1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
  - 2. Door Design: Wide stile; 5-inch (127-mm) nominal width

- 3. Bottom Rail: As indicated on Drawings...
- 4. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
  - a. Provide nonremovable glazing stops on outside of door.

## 2.7 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
  - 1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
  - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
  - 3. Opening-Force Requirements:
    - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N)to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
    - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
- C. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
  - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
  - 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Silencers: BHMA A156.16, Grade 1.
- E. Glazing: Comply with Section 088000 "Glazing."
- F. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- G. Glazing Sealants: Comply with Section 088000 "Glazing."

#### 2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

- 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
- 2. Reinforce members as required to receive fastener threads.
- 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
  - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

# 2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Provisions for field replacement of glazing from exterior.
  - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- F. Storefront Framing: Fabricate components for assembly using shear-block system.
- G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

- 1. At exterior doors, provide compression weather stripping at fixed stops.
- 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
  - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
  - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- J. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

### 2.10 ALUMINUM FINISHES

- A. A. Anodize Finish: AA-M10C22A41 or AA-M10C22A44, Class I, 0.7 mils min.
  - 1. Color: As selected by Architect from manufacturer's standard color.

#### 2.11 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

# PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

### 3.3 INSTALLATION

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure nonmovement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
  - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
  - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

### 3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
  - 1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
  - 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).

- 3. Alignment:
  - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
  - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
  - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
- 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

# 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
    - a. Perform tests in each test area as directed by Architect.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 087100 - DOOR HARDWARE

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Mechanical door hardware for the following:
    - a. Swinging doors.
  - 2. Cylinders for door hardware specified in other Sections.
  - 3. Electrified door hardware.
- B. Related Sections:
  - 1. Division 08 Section "Hollow Metal Doors and Frames".
  - 2. Division 08 Section "Flush Wood Doors" for integral intumescent seals provided as part of labeled fire-rated assemblies.
  - 3. Division 08 Section "Coiling Counter Doors" for door hardware provided as part of overhead door assemblies.
  - 4. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for installation of entrance door hardware, including cylinders.
  - 5. Division 28 Section "Common Work Results for electronic Safety and Security" for detection devices installed at door openings and provided as part of an intrusion-detection system.
  - 6. Division 28 Section "Digital, Addressable Fire-Alarm System" for connections to building fire-alarm system.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Details of electrified door hardware, indicating the following:
  - 1. Wiring Diagrams: For power, signal, and control wiring and including the following:
    - a. Details of interface of electrified door hardware and building safety and security systems.

- b. Schematic diagram of systems that interface with electrified door hardware.
- c. Point-to-point wiring.
- d. Risers.
- e. Elevations doors controlled by electrified door hardware.
- 2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
- C. Other Action Submittals:
  - 1. Door Hardware Schedule: Prepared by or under the supervision of an Architectural Hardware Consultant (AHC). Supplier to have an AHC in their employment. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware. Coordinate electrical components with electrical contractor and access control contractor.
    - a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
    - b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
    - c. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
    - d. Content: Include the following information:
      - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
      - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
      - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
      - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
      - 5) Fastenings and other pertinent information.
      - 6) Explanation of abbreviations, symbols, and codes contained in schedule.
      - 7) Mounting locations for door hardware.
      - 8) List of related door devices specified in other Sections for each door and frame.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For electrified door hardware, from the manufacturer.
  - 1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

- B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- C. Warranty: Special warranty specified in this Section.

# 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.
- B. Provide manufacturer's invoice numbers to Owner for warranty purposes.

# 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
  - 1. Warehousing Facilities: In Project's vicinity.
  - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
  - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
  - 1. For door hardware, an Architectural Hardware Consultant (AHC).
- C. Source Limitations: Obtain each type of door hardware from a single manufacturer.
  - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

- 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- G. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- H. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
  - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
  - 2. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
  - 4. Closers: Adjust door and gate closer sweep periods so that, from an open position of 90 degrees, the time required to move the door to a position of 12 degrees from the latch is 5 seconds minimum.
- I. Keying Conference: Provided by Best Locking Systems.
  - 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 diagram.
  - 3. Requirements for key control system.
  - 4. Requirements for access control.
  - 5. Address for delivery of keys.
- J. Pre-installation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Inspect and discuss preparatory work performed by other trades.
  - 3. Inspect and discuss electrical roughing-in for electrified door hardware.
  - 4. Review sequence of operation for each type of electrified door hardware.
  - 5. Review required testing, inspecting, and certifying procedures.

# 1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.
- E. Return Schlage SFIC temporary construction cores (used in cylindrical locksets) to hardware supplier upon completion of installation of permanent Best cores.

# 1.8 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- 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.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

### 1.9 WARRANTY

- A. 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. Failures include, but are not limited to, the following:
    - a. Structural failures including excessive deflection, cracking, or breakage.
    - b. Faulty operation of doors and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
    - a. Cylindrical Locks: Seven years from date of Substantial Completion.
    - b. Exit Devices: Two years from date of Substantial Completion.
    - c. Electrified Hardware: One year from date of Substantial Completion.
    - d. Manual Closers: Thirty years from date of Substantial Completion.

### 1.10 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide [six] <Insert number> months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

# PART 2 - PRODUCTS

# 2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled on Drawings to comply with requirements in this Section.
  - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
  - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
  - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
  - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

# 2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. **\***IVE: Ives Hardware
    - b. BOM: Bommer
    - c. MCK: McKinney

- 2.3 OFFSET PIVOTS
  - A. Offset Pivots: BHMA A156.4.
    - 1. Manufacturers: (\*) specified manufacturer
      - a. **\***IVE: Ives Hardware
      - b. RIX: Rixson

# 2.4 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
  - 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
  - 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
  - 3. Deadbolts: Minimum 1-inch (25-mm) bolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.
- D. Lock Trim:
  - 1. Levers: Cast
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latch bolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
- F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. \*SCH: Schlage ND Series. Owner Standard
- G. Mortise Locks: BHMA A156.13; Grade 1; stamped steel case with steel or brass parts; Series 1000.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. \*SCH: Schlage L9000 Series. Owner Standard

# 2.5 ELECTRIC STRIKES

- A. Electric Strikes: BHMA A156.31; Grade 1; with faceplate to suit lock and frame.
  - 1. Manufacturers: (\*) specified manufacturer

a. \*VON: Von Duprin 6000 Series. Owner Standard

#### 2.6 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. **\***IVE: Ives Hardware
    - b. DCI: Door Controls International
    - c. TRI: Trimco

### 2.7 AUTOMATIC FLUSH BOLTS

- A. Automatic Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. **\***IVE: Ives Hardware
    - b. DCI: Door Controls International
    - c. TRI: Trimco

# 2.8 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. \*VON: Von Duprin 98 Series. Owner Standard

#### 2.9 LOCK CYLINDERS

- A. Permanent Cylinder Cores: 7-Pin Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. \*BES: Best Locking Systems. Owner Standard
- B. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

### 2.10 KEYING

- A. Keying System: Best Locking Systems' factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
  - 1. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
    - a. Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver or Brass.
  - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
    - a. Notation: Information to be furnished by Owner.
  - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
    - a. Cylinder Change Keys: Three.
    - b. Master Keys: Five.
    - c. Grand Master Keys: Five.

#### 2.11 KEY CONTROL SYSTEM

- A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing keyholding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
  - 1. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
  - 2. Manufacturers: (\*) specified manufacturer
    - a. TELKEY
    - b. LUND
- B. Key Lock Boxes: Designed for storage of two keys, with tamper switches to connect to intrusion detection system.
- C. Cross-Index System: Single-index system for recording key information. Include three receipt forms for each key-holding hook. Set up by key control manufacturer.
- D. Key Control System Software: BHMA A156.5, Grade 1; multiple-index system for recording and reporting key-holder listings, tracking keys and lock and key history, and printing receipts for transactions. Include instruction manual.

### 2.12 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. **\***IVE: Ives Hardware
    - b. DCI: Door Controls International
    - c. TRI: Trimco
- B. Astragals: BHMA A156.22.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. \*ZER: Zero International
    - b. NGP: National Guard Products
    - c. PEM: Pemko

### 2.13 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. \*LCN: LCN 4040XP Series. Owner Standard

#### 2.14 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; Brass or bronze base metal.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. **\***IVE: Ives Hardware
    - b. TRI: Trimco

# 2.15 ELECTROMAGNETIC STOPS AND HOLDERS

- A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic unit with plate attached to swinging door(s); coordinated with fire detectors and interface with fire alarm system for labeled fire-rated door assemblies.
  - 1. Manufacturers: (\*) specified manufacturer

- a. \*LCN: LCN SEM 7850
- b. RIX: Rixson FM 998

# 2.16 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. \*GLY: Glynn Johnson. Owner Standard

### 2.17 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. \*ZER: Zero International
    - b. NGP: National Guard Products
    - c. PEM: Pemko

#### 2.18 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. \*ZER: Zero International
    - b. NGP: National Guard Products
    - c. PEM: Pemko

### 2.19 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or wood screw fasteners.
  - 1. Manufacturers: (\*) specified manufacturer
    - a. **\***IVE: Ives Hardware
    - b. TRI: Trimco

### 2.20 AUXILIARY ELECTRIFIED DOOR HARDWARE

- A. Auxiliary Electrified Door Hardware:
  - 1. Manufacturers: (\*) specified manufacturer
    - a. \*VON: Von Duprin. Owner Standard
    - b. \*SCE: Schlage Electronics. Owner Standard

#### 2.21 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
  - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  - 2. Fire-Rated Applications:
    - a. Wood or Machine Screws: For the following:
      - 1) Hinges mortised to doors or frames; use threaded-to-the-head screws. Provide wood screws, machine screws, or combination for each door and frame application.
      - 2) Strike plates to frames.
      - 3) Closers to doors and frames.
    - b. Steel Through Bolts: For the following:
      - 1) Fire Exit Hardware.
  - 3. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors." Provide solid hardware blocking.

4. Hard Gasketing Fasteners: Provide non-corrosive fasteners for exterior hollow metal frame applications and elsewhere as indicated.

### 2.22 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

# 3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
  - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.
  - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
  - 1. Replace construction cores with permanent cores as directed by Owner.
  - 2. Furnish permanent cores to Owner for installation.
- F. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, **above** accessible ceiling or in equipment room. Verify location with Division 28 and Architect.
  - 1. Configuration: Provide one power supply for each door opening or least number of power supplies required to adequately serve doors with electrified door hardware.
- H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

## 3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
  - 1. Independent 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.

### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  - 1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
  - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
  - 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

# 3.6 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.

# 3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 017900 "Demonstration and Training."

### 3.8 DOOR / HARDWARE INDEX:

Door #	HWSet #	Remarks
100A	01	
100B	02	
100C	03	
100D	03	
100E	04	
101	05	
101A	06	
102	05	
103	05	
103A	07	
103B	08	
104A	09	
104B	10	
105A	11	
105B	12	
105C	13	
105D	14	
105E	15	
105F	17	
105G	18	
105H	16	
106	19	
109A	20	
109B	16	
109C	16	
112	04	
113	21	
114	22	
117A	22	
117B	22	
118	08	

## 3.9 DOOR HARDWARE SETS:

#### HW SET: 01

DOOR NUMBER: 100A

# EACH TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	<u>MFR</u>
6	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	KEYED REMOVABLE	KR4954-STAB	689	VON
		MULLION			
2	EA	PANIC HARDWARE	LD-98-L-2SI-06	626	VON
1	EA	SFIC MORTISE CYL.	80-133 GRN 36-083 36-082-037	626	SCH
4	EA	SFIC RIM CYLINDER	80-159 GRN	626	SCH
5	EA	PERMANENT CORE	1C7	626	BES
2	EA	SURFACE CLOSER	4040XP EDA WMS	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CCV	630	IVE
4	EA	SILENCER	SR64	GRY	IVE

ALTERNATE 1: CHANGE TO FIRE RATED ASSEMBLY. VON DUPRIN KR9954-STAB MULLION, 98-L-F-2SI-06, ZERO 188S GASKET AND 8780N MULLION SEAL.

#### HW SET: 02

DOOR NUMBER: 100B

#### EACH TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	<u>MFR</u>
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	LD-98-L-2SI-06	626	VON
2	EA	SFIC RIM CYLINDER	80-159 GRN	626	SCH
2	EA	PERMANENT CORE	1C7	626	BES
1	EA	SURFACE CLOSER	4040XP EDA WMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

ALTERNATE 1: CHANGE TO FIRE RATED ASSEMBLY. VON DUPRIN 98-L-F-2SI-06 AND ZERO 188S GASKET.

# HW SET: 03

DOOR NUMBER: 100C 100D

#### EACH TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
6	EA	HW HINGE	5BB1HW 5 X 4.5 NRP	630	IVE
1	EA	KEYED REMOVABLE	KR4954-STAB	689	VON
		MULLION			
2	EA	PANIC HARDWARE	LD-98-EO	626	VON
1	EA	SFIC MORTISE CYL.	80-133 GRN 36-083 36-082-037	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188S-BK	S-BK	ZER
1	EA	MULLION SEAL	8780N	Ν	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	103A-MSLA-10	А	ZER
1	EA	RAIN DRIP	142A	А	ZER

NOTE: EXIT ONLY. NO EXTERIOR TRIM.

# HW SET: 04

DOOR NUMBER: 100E 112

EACH TO HAVE:

QTY	DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
		REUSE EXISTING HARDWARE		

NOTE: FIELD CONFIRM EXISTING HARDWARE IS SERVICEABLE AND COMPLETE. ADVISE OF ANY FAULTY OR MISSING HARDWARE.

#### **HW SET: 05**

DOOR NUI		
101	102	103

#### EACH TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
2	EA	OH STOP	90S	630	GLY
1	EA	ASTRAGAL	43SP	SP	ZER
4	EA	SILENCER	SR64	GRY	IVE

# HW SET: 06

DOOR NUMBER: 101A

# EACH TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
1	EA	LOCK GUARD	LG14	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH WMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188S-BK	S-BK	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	103A-MSLA-10	А	ZER
1	EA	RAIN DRIP	142A	А	ZER

### HW SET: 07

DOOR NUMBER: 103A

#### EACH TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

#### HW SET: 08

DOOR NUMBER	<b>?</b> :
103B	118

# EACH TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<b>FINISH</b>	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

# HW SET: 09

### DOOR NUMBER: 104A

EACH	І ТО НА	VE:			
QTY		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
1	EA	PIVOT SET	7226 SET	626	IVE

1	EA	INTERMEDIATE PIVOT	7226 INT	626	IVE
1	EA	PANIC HARDWARE	LD-98-EO-1439	626	VON
1	EA	SURFACE CLOSER	4040XP SCUSH WMS	689	LCN
1	EA	CUSH SHOE SUPPORT	4040-30	689	LCN
1	EA	BLADE STOP SPACER	4040-61	689	LCN
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	103A-MSLA-10	А	ZER
1	EA	RAIN DRIP	142A	А	ZER
			WEATHERSTRIP BY DOOR/FRAME		
			MANUFACTURER		

NOTE: EXIT ONLY. NO EXTERIOR TRIM.

<u>HW SET: 10</u>

DOOR NUMBER: 104B

#### EACH TO HAVE:

	DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
EA	KEYED FIRE RATED	KR9954-STAB	689	VON
	REMOVABLE MULLION			
EA	FIRE EXIT HARDWARE	98-L-F-2SI-06	626	VON
EA	SFIC MORTISE CYL.	80-133 GRN 36-083 36-082-037	626	SCH
EA	SFIC RIM CYLINDER	80-159 GRN	626	SCH
EA	PERMANENT CORE	1C7	626	BES
EA	OH STOP	100S ADJ	630	GLY
EA	SURFACE CLOSER	4040XP EDA WMS	689	LCN
EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
EA	GASKETING	188S-BK	S-BK	ZER
EA	MULLION SEAL	8780N	Ν	ZER
	EA EA EA EA EA EA EA EA EA EA	DESCRIPTIONEAHW HINGEEAKEYED FIRE RATEDREMOVABLE MULLIONEAFIRE EXIT HARDWAREEASFIC MORTISE CYL.EASFIC RIM CYLINDEREAPERMANENT COREEAOH STOPEASURFACE CLOSEREAGASKETINGEAMULLION SEAL	EADESCRIPTION HW HINGECATALOG NUMBER 5BB1HW 4.5 X 4.5 NRPEAHW HINGE5BB1HW 4.5 X 4.5 NRPEAKEYED FIRE RATED REMOVABLE MULLIONKR9954-STABEAFIRE EXIT HARDWARE98-L-F-2SI-06EASFIC MORTISE CYL.80-133 GRN 36-083 36-082-037EASFIC RIM CYLINDER80-159 GRNEAPERMANENT CORE1C7EAOH STOP100S ADJEASURFACE CLOSER4040XP EDA WMSEAKICK PLATE8400 10" X 2" LDW B-CSEAMULLION SEAL8780N	EADESCRIPTION HW HINGECATALOG NUMBER 5BB1HW 4.5 X 4.5 NRPFINISH 652EAKEYED FIRE RATED REMOVABLE MULLIONKR9954-STAB689EAFIRE EXIT HARDWARE SFIC MORTISE CYL.98-L-F-2SI-06626EASFIC RIM CYLINDER PERMANENT CORE80-133 GRN 36-083 36-082-037626EAPERMANENT CORE IC7100S ADJ630EASURFACE CLOSER GASKETING4040XP EDA WMS689EAKICK PLATE GASKETING8400 10" X 2" LDW B-CS630EAMULLION SEAL8780NN

### HW SET: 11

DOOR NUMBER: 105A

#### EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
2	EA	PIVOT SET	7226 SET	626	IVE
2	EA	INTERMEDIATE PIVOT	7226 INT	626	IVE
1	EA	KEYED REMOVABLE	KR4954-STAB	689	VON
		MULLION			
2	EA	PANIC HARDWARE	HDSI-98-DT	626	VON
1	EA	SFIC MORTISE CYL.	80-133 GRN 36-083 36-082-037	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
2	EA	OH STOP	100S ADJ	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA WMS	689	LCN
2	EA	BLADE STOP SPACER	4040-61	689	LCN
1	EA	MULLION SEAL	8780N	Ν	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER

1	EA	THRESHOLD	103A-MSLA-10	А	ZER
1	EA	RAIN DRIP	142A	А	ZER
			WEATHERSTRIP BY DOOR/FRAME		
			MANUFACTURER		

ALTERNATE 1: CHANGE TO ACCESS CONTROLLED OPENING. ADD 2 VON DUPRIN EPT10 POWER TRANSFERS, 2 RX-QEL-98-DT PANIC DEVICES, 1 PS902 900BBK 900-2RS POWER SUPPLY. PROVIDE FACTORY POINT TO POINT AND RISER DIAGRAMS.

# <u>HW SET: 12</u>

DOOR NUMBER: 105B

#### EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	<b>FINISH</b>	MFR
2	EA	PIVOT SET	7226 SET	626	IVE
2	EA	INTERMEDIATE PIVOT	7226 INT	626	IVE
1	EA	KEYED REMOVABLE	KR4954-STAB	689	VON
		MULLION			
1	EA	PANIC HARDWARE	HDSI-98-DT	626	VON
1	EA	PANIC HARDWARE	HDSI-98-NL	626	VON
1	EA	SFIC MORTISE CYL.	80-133 GRN 36-083 36-082-037	626	SCH
1	EA	SFIC RIM CYLINDER	80-159 GRN	626	SCH
2	EA	PERMANENT CORE	1C7	626	BES
2	EA	OH STOP	100S ADJ	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA WMS	689	LCN
2	EA	BLADE STOP SPACER	4040-61	689	LCN
1	EA	MULLION SEAL	8780N	N	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	103A-MSLA-10	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
			WEATHERSTRIP BY DOOR/FRAME		
			MANUFACTURER		

ALTERNATE 1: CHANGE TO ACCESS CONTROLLED OPENING. ADD 2 VON DUPRIN EPT10 POWER TRANSFERS, 1 RX-QEL-98-DT PANIC DEVICE, 1 RX-QEL-98-NL PANIC DEVICE, 1 PS902 900BBK 900-2RS POWER SUPPLY. PROVIDE FACTORY POINT TO POINT AND RISER DIAGRAMS.

#### <u>HW SET: 13</u>

DOOR NUMBER: 105C

#### EACH TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO	626	SCH
2	EA	PERMANENT CORE	1C7	626	BES
1	EA	SURFACE CLOSER	4040XP REG WMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188S-BK	S-BK	ZER

#### HW SET: 14

DOOR NUMBER:

105D

#### EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
2	EA	PIVOT SET	7226 SET	626	IVE
2	EA	INTERMEDIATE PIVOT	7226 INT	626	IVE
1	EA	PANIC HARDWARE	LD-9849-EO	626	VON
1	EA	PANIC HARDWARE	LD-9849-L-06	626	VON
1	EA	SFIC RIM CYLINDER	80-159 GRN	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
2	EA	MAGNETIC LOCK	M490P	628	SCE
2	EA	TJ BRACKET	TJ490	630	SCE
2	EA	SURFACE CLOSER	4040XP SCUSH SRI WMS	689	LCN
2	EA	CUSH SHOE SUPPORT	4040-30	689	LCN
2	EA	BLADE STOP SPACER	4040-61	689	LCN
2	EA	DOOR SWEEP	39A	А	ZER
1	EA	THRESHOLD	103A-MSLA-10	А	ZER
1	EA	POWER SUPPLY	PS902 900-BBK FA900	LGR	SCE
			ACCESS CONTROL - WORK OF		
			DIVISION 28		
			EMERGENCY PULL STATION - WORK		
			OF DIVISION 28		
			PROVIDE FACTORY POINT TO POINT		
			WIRING DIAGRAMS		
			PROVIDE RISER DIAGRAMS		
			WEATHERSTRIP BY DOOR/FRAME		
			MANUFACTURER		

NOTE: 120VAC TO POWER SUPPLY. MAG LOCKS RELEASE ON ACCESS CONTROL, EMERGENCY PULL STATION ON INSIDE, OR POWER FAILURE. MAG LOCKS INSTALL ON PULL SIDE OF DOORS WITH SPECIAL MOUNTING BRACKETS. TWO SEPARATE MAG LOCKS ARE SPECIFIED. INSTALL ON DOORS AND FRAME TO CLEAR INTERNAL PANIC DEVICE COMPONENTS. PANIC DEVICES ARE INTERNAL CONCEALED CABLE DEVICES TO PREVENT TAMPERING WITH A REMOVABLE MULLION. ACTIVE LEAF HAS LOCKABLE LEVER ON INSIDE TO CONTROL INTERIOR LOCKING DURING GAMES. INACTIVE LEAF IS EXIT ONLY WITH NO PULL SIDE TRIM. BOTH DEVICES ARE "LESS DOGGING". NOTE THAT CLOSERS ARE MOUNTED ON EXTERIOR PUSH SIDE OF DOORS. THIS IS NECESSARY DUE TO THE AMOUNT OF ROOM NEEDED ON THE DOORS FOR THE MAG LOCKS ON THE INSIDE. THE CLOSERS ARE SPECIFIED WITH A RUST INHIBITING COATING (SRI).

#### HW SET: 15 DOOR NUMBER: 105E

EACH TO HAVE: <u>QTY</u><u>DESCRIPTION</u>

#### CATALOG NUMBER

FINISH MFR

ELMIRA HIGH SCHOOL DLR GROUP PROJECT NO. 74-13107-40 FERN RIDGE SCHOOL DISTRICT PERMIT & BID SET ELMIRA, OREGON MARCH 3, 2016

2	EA	PIVOT SET	7226 SET	626	IVE
2	EA	INTERMEDIATE PIVOT	7226 INT	626	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	CLASSROOM LOCK	L9070HD LLL 06A L283-150 (NO EXTERIOR TRIM-LOCKABLE LEVER ON INSIDE ONLY)	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH ST-2648 WMS (PROVIDE CUSTOM STOP SHIM IF NECESSARY FOR INSTALLATION OF COORDINATOR)	689	LCN
1	EA	ASTRAGAL	43STST (PULL SIDE ACTIVE LEAF)	STST	ZER
2	EA	DOOR SWEEP	39A	А	ZER
1	EA	THRESHOLD	103A-MSLA-10 WEATHERSTRIP BY DOOR/FRAME MANUFACTURER	A	ZER

# <u>hv</u> DC 9ET. 16

<u>HW SET: 16</u>				
DOOR NUME	BER:			
105H	109B	109C		
EACH TO HA	VE:			
<u>QTY</u>	DESCRIPTION		<u>CATALOG NUMBER</u> HARDWARE BY DOOR MANUFACTURER	<u>FINISH</u>

# <u>HW SET: 17</u>

DOOR NUMBER: 105F

# EACH TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
2	EA	PIVOT SET	7226 SET	626	IVE
2	EA	INTERMEDIATE PIVOT	7226 INT	626	IVE
1	EA	KEYED REMOVABLE	KR4954-STAB	689	VON
		MULLION			
2	EA	PANIC HARDWARE	HDSI-98-DT	626	VON
1	EA	SFIC MORTISE CYL.	80-133 GRN 36-083 36-082-037	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
2	EA	OH STOP	100S ADJ	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA WMS	689	LCN
1	EA	SURFACE CLOSER	4040XP SCUSH WMS	689	LCN
1	EA	CUSH SHOE SUPPORT	4040-30	689	LCN
2	EA	BLADE STOP SPACER	4040-61	689	LCN
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	MULLION SEAL	8780N	Ν	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER

<u>MFR</u>

1	EA	THRESHOLD	103A-MSLA-10	А	ZER
1	EA	RAIN DRIP	142A	А	ZER
			WEATHERSTRIP BY DOOR/FRAME		
			MANUFACTURER		

ALTERNATE 1

#### HW SET: 18

DOOR NUMBER: 105G

# EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	PIVOT SET	7226 SET	626	IVE
1	EA	INTERMEDIATE PIVOT	7226 INT	626	IVE
1	EA	PANIC HARDWARE	HDSI-98-NL	626	VON
1	EA	SFIC RIM CYLINDER	80-159 GRN	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
1	EA	ELECTRIC STRIKE	6111 FSE 24VDC SHIM	630	VON
1	EA	SURFACE CLOSER	4040XP EDA WMS	689	LCN
1	EA	BLADE STOP SPACER	4040-61	689	LCN
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	103A-MSLA-10	А	ZER
1	EA	RAIN DRIP	142A	А	ZER
1	EA	DESK MOUNT BUTTON	660-PB	628	SCE
			WEATHERSTRIP BY DOOR/FRAME		
			MANUFACTURER		

### NOTE: REMOTE RELEASE LOCATED IN ADMIN/RECEPTION.

### HW SET: 19

DOOR NUMBER: 106

#### EACH TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CORRIDOR	L9456HD 06A L583-363 L283-722	626	SCH
		W/DEADBOLT			
1	EA	PERMANENT CORE	1C7	626	BES
1	EA	SURFACE CLOSER	4040XP REG WMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188S-BK	S-BK	ZER

# HW SET: 20

DOOR NUMBER: 109A

#### EACH TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<b>FINISH</b>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
1	EA	SURFACE CLOSER	4040XP EDA WMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

#### HW SET: 21

DOOR NUMBER:

113

#### EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM DEADBOLT	B663GD	626	SCH
1	EA	PERMANENT CORE	1C7	626	BES
1	EA	PUSH PLATE	8200 4" X 16" CFC	630	IVE
1	EA	PULL PLATE	8302 8" 4" X 16" CFT G	630	IVE
1	EA	SURFACE CLOSER	4040XP REG WMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

NOTE: CLASSROOM DEADLOCK - DEADBOLT THROWN OR RETRACTED BY KEY OUTSIDE. INSIDE THUMB TURN RETRACTS DEADBOLT BUT CANNOT PROJECT IT. INSTALL DEADLOCK AT 48" CL AFF.

#### HW SET: 22

DOOR NUMBER:					
114	117A	117B			

#### EACH TO HAVE:

<u>QTY</u>		<b>DESCRIPTION</b>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8302 6" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA WMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION 087100

SECTION 088000 - GLAZING

# PART 1 - GENERAL

## 1.1 GENERAL

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. Glass for doors and storefront framing.
  - 2. Glazing sealants and accessories.
- B. Related Requirements:
  - 1. Section 084113 "Aluminum-framed Entrances and Storefronts" for exterior storefront systems.
  - 2. Section 086200 "Unit Skylights" for glazing requirements at unit skylights.

# 1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

#### 1.4 COORDINATION

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

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
- B. Glass Samples: For the following products; 12 inches square.
  - 1. Clear fully tempered float glass (CG). Refer to schedule at the end of this section for performance requirements.
  - 2. Low-E Insulating Glass (CTIG). Refer to schedule at the end of this section for performance requirements.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass.
- B. Sample Warranties: For special warranties.
- 1.7 QUALITY ASSURANCE
  - A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
  - B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
  - C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
  - D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### 1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

### 1.10 WARRANTY

- A. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Glass Product: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:
  - 1. AGC Glass Company North America, Inc.
  - 2. Berkowitz, JE, LP.
  - 3. Cardinal Glass Industries.
  - 4. Cristacurva Glass.
  - 5. Dlubak Corporation.
  - 6. Gardner Glass Products, Inc.
  - 7. General Glass International.
  - 8. Glasswerks LA, Inc.
  - 9. Glaz-Tech Industries.
  - 10. Guardian Industries Corp.
  - 11. Hartung Glass Industries.
  - 12. Northwestern Industries, Inc.
  - 13. Oldcastle BuildingEnvelope.
  - 14. Pilkington North America Inc.
  - 15. PPG Industries, Inc.
  - 16. Saint-Gobain Corporation.
  - 17. Schott North America, Inc.
  - 18. Tecnoglass S. A.
  - 19. Trulite Glass & Aluminum Solutions.
  - 20. Viracon, Inc.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
  - 1. Obtain tinted glass from single source from single manufacturer.
  - 2. Obtain reflective-coated glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

## 2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
    - a. Basic Wind Speed: 85 mph.
    - b. Importance Factor: 1.0.
    - c. Exposure Category: C.
  - 3. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
  - 4. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
  - 5. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
  - 6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
  - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  - 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  - 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.

5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: "Glazing Manual."
  - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
  - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
  - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heatstrengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heatstrengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

### 2.4 GLASS PRODUCTS

- A. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Quality-Q3.

- 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Ceramic-Coated Vision Glass: ASTM C 1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in GANA's "Engineering Standards Manual."
- D. Ceramic-Coated Spandrel Glass: ASTM C 1048, Type I, Condition B, Quality-Q3.

# 2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
  - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
  - 2. Spacer: Manufacturer's standard spacer material and construction.
  - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

# 2.6 GLAZING SEALANTS

- A. General:
  - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  - 3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
  - 4. Sealants shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

# 2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
  - 1. AAMA 804.3 tape, where indicated.
  - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

#### 2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
    - a. Temperature Change: 120 deg F , ambient; 180 deg F, material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

#### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

- 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
- 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

## 3.4 TAPE GLAZING

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

## 3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

## 3.6 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

## 3.7 MONOLITHIC GLASS SCHEDULE

- A. Glass Type (CG): Clear fully tempered float glass at all interior glazing unless noted otherwise.
  - 1. Minimum Thickness: 6 mm.
  - 2. Safety glazing required.

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## 3.8 INSULATING GLASS SCHEDULE

- A. Low-E Insulating Glass (CTIG) at all exterior glazing unless noted otherwise.
  - 1. Guardian SunGuard SuperNeutral 54 (#2), Clear, Clear.
  - 2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm.
  - 3. Interspace Content: Air.
  - 4. Indoor Lite: Float glass, Class 1 (clear) float glass, (Fully Tempered), Condition A (uncoated surfaces) as required.
  - 5. Outdoor Lite: Float glass, Class 1 (clear), Kind FT (Fully Tempered), Condition C (other coated glass).
  - 6. Low-Emissivity Coating: Sputter-coated on second surface.
  - 7. Visible Light Transmittance: 54 percent minimum.
  - 8. Winter Nighttime U-Value: 0.29 maximum.
  - 9. Summer Daytime U-Value: 0.27 maximum.
  - 10. Shading Coefficient: 0.32.
  - 11. SHGC: 0.28 max in accordance with NFRC 200.

END OF SECTION 088000

SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior gypsum board.
  - 2. Tile backing panels.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

## 2.2 GYPSUM BOARD, GENERAL

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

### 2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 1396/C 1396M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed Corporation.
    - c. Georgia-Pacific Building Products.
    - d. PABCO Gypsum.
    - e. Temple-Inland Building Products by Georgia-Pacific.
    - f. United States Gypsum Company.
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed Corporation.
    - c. Georgia-Pacific Building Products.
    - d. PABCO Gypsum.
    - e. Temple-Inland Building Products by Georgia-Pacific.
    - f. United States Gypsum Company.
  - 2. Thickness: 5/8 inch (15.9 mm).
  - 3. Long Edges: Tapered.
- C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

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- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Gypsum.
  - b. CertainTeed Corporation.
  - c. Georgia-Pacific Building Products.
  - d. PABCO Gypsum.
  - e. Temple-Inland Building Products by Georgia-Pacific.
  - f. United States Gypsum Company.
- 2. Thickness: 5/8 inch (15.9 mm).
- 3. Long Edges: Tapered.
- D. Abuse-Resistant Gypsum Board (bottom 8' in Lobby and Gymnasium): ASTM C 1629/C 1629M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed Corporation.
    - c. Georgia-Pacific Building Products.
    - d. PABCO Gypsum.
    - e. Temple-Inland Building Products by Georgia-Pacific.
    - f. United States Gypsum Company.
  - 2. Core: 5/8 inch (15.9 mm), Type X.
  - 3. Long Edges: Tapered.
  - 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- E. Moisture- and Mold-Resistant Gypsum Board: ASTM C1396 and as follows:
  - 1. Type: Regular, unless shown otherwise.
  - 2. Thickness: 5/8 inch, unless shown otherwise.
  - 3. Long Edges: Tapered.
  - 4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
  - 5. Location: At locker rooms (walls and ceilings).

## 2.4 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Georgia-Pacific Building Products.

- 2. Core: 5/8 inch (15.9 mm), Type X.
- 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

### 2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
  - 2. Shapes:
    - a. Cornerbead.
    - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - c. Expansion (control) joint.

## 2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  - 1. Interior Gypsum Board: Paper.
  - 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
  - 3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
  - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
- D. Joint Compound for Exterior Applications:
  - 1. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.
- E. Joint Compound for Tile Backing Panels:
  - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

### 2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. 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. Accumetric LLC.
    - b. Grabber Construction Products.
    - c. Pecora Corporation.
    - d. Specified Technologies, Inc.
    - e. United States Gypsum Company.
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- F. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

#### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

## 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
  - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- B. Multilayer Application:
  - 1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
  - 2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

### 3.4 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

## 3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:

- 1. Cornerbead: Use at outside corners unless otherwise indicated.
- 2. LC-Bead: Use at exposed panel edges.

### 3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in other Division 09 Sections.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

#### 3.7 **PROTECTION**

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Porcelain floor tile.
  - 2. Glazed wall tile.
  - 3. Metal edge strips.
  - 4. Crack isolation membrane.
- B. Related Requirements:
  - 1. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
  - 1. Division 09 Section "Gypsum Board" for tile backing units.

#### 1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
  - 1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
  - 2. Full-size units of each type of trim and accessory for each color and finish required.
  - 3. Metal edge strips in 6-inch (150-mm) lengths.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product.
- D. Product Test Reports: For tile-setting and -grouting products.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

## 1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

### PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
  - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
  - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
  - 1. Metal edge strips.
  - 2. Crack isolation membrane.

## 2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
  - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

## 2.3 TILE PRODUCTS

- A. Ceramic Tile Type CT-1 CT-5: porcelain and ceramic tile.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
  - 2. Certification: Tile certified by the Porcelain Tile Certification Agency.
  - 3. Face Size: As indicated on drawings...
  - 4. Tile Color, Glaze, and Pattern: As indicated on drawings.
  - 5. Grout Color: As indicated on drawings.

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### 2.4 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (MUD SET):
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products; a QEP company.
    - b. Bonsal American; an Oldcastle company.
    - c. Bostik, Inc.
    - d. C-Cure.
    - e. Custom Building Products.
    - f. Jamo Inc.
    - g. Laticrete International, Inc.
    - h. MAPEI Corporation.
    - i. Mer-Kote Products, Inc.
    - j. Southern Grouts & Mortars, Inc.
    - k. Summitville Tiles, Inc.
    - 1. TEC; a subsidiary of H. B. Fuller Company.
  - 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
  - 3. Provide prepackaged, dry-mortar mix combined with-latex additive at Project site.
  - 4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- B. Polymer-Modified Tile Grout: ANSI A118.7.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products; a QEP company.
    - b. Bonsal American; an Oldcastle company.
    - c. Bostik, Inc.
    - d. C-Cure.
    - e. Custom Building Products.
    - f. Jamo Inc.
    - g. Laticrete International, Inc.
    - h. MAPEI Corporation.
    - i. Southern Grouts & Mortars, Inc.
    - j. Summitville Tiles, Inc.
    - k. TEC; a subsidiary of H. B. Fuller Company.
- 2.5 Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
  - A. Elastomeric Sealants: Provide elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 07 Section "Joint Sealants."

- B. Glass-Mat Backing Board: ASTM C 1178/C in lengths to minimize end-to-end butt joints.
  - 1. Thickness: 1/2 inch.
    - a. Product: Subject to compliance with requirements, provide "DensShield Tile Guard" by G-P Gypsum.
- C. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials.
- D. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.
- E. Metal transition strips: to conceal gaps and prevent lifting, provide an integral leg transition strip that conceals both adjoining floor surfaces. Basis of Design: Schluter-RENO-U, in stainless steel; roll-formed using 304 (1.4301 = V2A) stainless steel with a profile designed to sustain high mechanical stresses and well suited for applications requiring resistance against chemicals and acids.
  - 1. Apply at all tile flooring edges abutting other flooring provide in a dark bronze finish.

#### 2.6 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.
- 2.7 MISCELLANEOUS MATERIALS
  - A. Crack Isolation Membrane: Self-bonding, fabric-reinforced asphaltic or plastic mat designed to reduce crack transmission in tile and stone floors.
    - 1. Basis-of-Design Product: Crack Buster Pro Crack Prevention Mat Underlayment as manufactured by Custom Building Products.

#### PART 3 - EXECUTION

# 3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
- 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
  - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
  - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
- 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
- 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

## 3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
  - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    - a. Tile floors in wet areas.
    - b. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
  - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
  - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
  - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  - 1. Pressed Floor Tile: 1/4 inch (6.4 mm).
  - 2. Glazed Wall Tile: 1/16 inch (1.6 mm).
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- K. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floorsealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

## 3.4 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  - 1. Remove grout residue from tile as soon as possible.
  - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

# 3.5 **PROTECTION**

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

## 3.6 FLOOR TILE INSTALLATION SCHEDULE

- A. Floor Tile, Typical: Install tile to comply with requirements indicated below for setting bed methods, TCNA installation methods related to types of subfloor construction, and grout types:
  - 1. Latex Modified Portland Cement Mortar: ANSI A108.4
    - a. Bond Coat: Latex-portland cement mortar, ANSI A108.4 or ANSI A108.5.
    - b. Concrete Subfloors, Typical: TCNA F115-11 (with tile installed by Method F113-12)
    - c. Grout: Polymer-Modified Tile Grout.
- B. Floor Tile, at existing building: Install tile to comply with requirements indicated below for setting bed methods, TCNA installation methods related to types of subfloor construction, and grout types:
  - 1. Crack Isolation Mat: TCNA F125-Partial Coverage.
  - 2. Latex Modified Portland Cement Mortar: ANSI A108.4
    - a. Bond Coat: Latex-portland cement mortar, ANSI A108.4 or ANSI A108.5.
    - b. Concrete Subfloors, Typical: TCNA F115-11 (with tile installed by Method F113-12)
    - c. Grout: Polymer-Modified Tile Grout.

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## 3.7 WALL TILE INSTALLATION SCHEDULE

- A. Install types of tile designated for wall application to comply with requirements indicated below for setting-bed methods, TCNA installation methods related to subsurface wall conditions, and grout types:
  - 1. Latex-Portland Cement Mortar: ANSI A108.4.
    - a. Cementitious Backer Units, Interior: TCNA W244C-11
    - b. Grout: Polymer-Modified Tile Grout.

END OF SECTION 093013

## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This section includes:
  - 1. Acoustical panels and exposed suspension systems for ceilings.
  - 2. Direct-applied acoustical panel tiles (Gym Ceiling)
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency a qualified testing agency.
- C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- D. Field quality-control reports.

### 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

### 1.6 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. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.

#### 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
  - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

#### 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

#### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- 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: Comply with ASTM E 1264 for Class A materials.
- 2. Smoke-Developed Index: 50 or less.

# 2.2 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations:
  - 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
  - 2. Suspension System: Obtain each type from single source from single manufacturer.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- C. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
  - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.
- E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

## 2.3 ACOUSTICAL PANELS (APC)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc.; or a comparable product by one of the following:
  - 1. BPB USA
  - 2. Chicago Metallic Corporation
  - 3. Ecophon CertainTeed, Inc.
  - 4. USG Interiors, Inc.
- B. APC: Standard tiles (used in all acoustical panel ceiling areas unless specifically noted otherwise)
  - 1. Armstrong Fine Fissured, .75 NRC, High Recycled content, 24" x 48".
  - 2. See reflect ceiling plans for location and orientation.

- C. Tectum Panels: Direct-applied acoustical ceiling panels (Gym)
  - 1. General: Plans show Tectum panels direct-mounted to roof deck in between joists that are 48" on center. After roof deck is painted, panels would be adhered to underside of roof deck on center between joists.
  - 2. Manufacturer: Tectum Inc., P.O. Box 3002, Newark, OH 43058, www.tectum.com (1-888-977-9691), Bevel Direct Attachment Panels or prior approved equal.
  - 3. Size: 24" x 48" x 1-1/2".
  - 4. Orientation: Attach panels so that 48" length is perpendicular to joists.
  - 5. Color: Factory painted white.
  - 6. NRC: .55 or better.
  - 7. Mounting Style: "D-20" Mounting.

## 2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
  - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  - 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch-(1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch-(8-mm-) diameter bolts.
- E. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- G. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

## 2.5 METAL SUSPENSION SYSTEM

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

- 1. Armstrong World Industries, Inc.
- 2. CertainTeed Corporation.
- 3. Chicago Metallic Corporation.
- 4. United States Gypsum Company.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
  - 1. Structural Classification: Intermediate-duty system.
  - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
  - 3. Face Design: Flat, flush.
  - 4. Cap Material: Steel cold-rolled sheet.
  - 5. Cap Finish: Painted white.
- C. Wide-Face, Capped, Double-Web, Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, G60 (Z180) coating designation; with prefinished, cold-rolled, 15/16inch- (24-mm-) wide aluminum caps on flanges.
  - 1. Structural Classification: Intermediate-duty system.
  - 2. Face Design: Flat, flush.
  - 3. Face Finish: Painted white.

#### 2.6 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Provide edge moldings and trim from same manufacturer as suspension system.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
  - 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
  - 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified

in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

# 3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

# 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - 8. Do not attach hangers to steel deck tabs.
  - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.

- 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
- 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  - 1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
  - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
  - 1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.
  - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  - 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  - 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
  - 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner may engage a qualified special inspector to perform the following special inspections:
  - 1. Compliance of seismic design.

- B. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
  - 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
    - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
    - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- C. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

# 3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

## SECTION 095430 – LIFT & LOCK WOOD TILES (WOOD CEILINGS)

PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes:
  - 1. Concealed suspension system for Lift & Lock Wood Tiles
  - 2. Lift & Lock Wood Tiles for concealed suspension system.
  - 3. Trim and accessories.
  - 4. Seismic restraints for suspended ceiling system.

#### 1.3 DEFINITIONS

- A. LR: Light Reflectance coefficient.
- B. NRC: Noise Reduction Coefficient.
- C. ASTM A 641: Standard Specification for Zinc Coated (Galvanized) Carbon Steel Wire; 1992.
- D. ASTM C 423: Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 1990.
- E. ASTMC C 635: Standard Specifications for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
- F. ASTM C 636: Standard Practice for Installation of Wood ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 1992.
- G. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials; 1991.
- H. ASTM E 580: Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint; 1991.
- I. AWI (QSI): Architectural Woodwork Quality Standards Illustrated; 2003.
J. CISCA: Ceiling Systems Handbook.

#### 1.4 COORDINATION

A. Coordinate layout and installation of lift & lock wood tile system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

# 1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

## 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For verification of each type of exposed finish required, prepared on samples of size indicated below. Where finishes involve normal color and texture variations, include sample sets showing the range of variations expected.
  - 1. 12" x 18" samples of each panel type, pattern, and color.
- C. Shop Drawings: Provide Shop Drawings/Coordination Drawings for all ceilings, which should include RCP and product details. Coordinate Wood Tile ceiling panels layout and installation of wood panels and suspension system components with other construction elements that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, partition assemblies and all perimeter conditions.
- D. Delegated-Design Submittal: For suspended cloud ceilings or other suspended ceiling assemblies not in compliance with prescriptive performance criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For lift & lock wood tiles and components and anchor and fastener type.
- B. Field quality-control reports.

# 1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

## 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer, approved by wood ceiling manufacturer, who has completed panel ceilings similar in species, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Inspection: All work must pass inspection and approval of architect, as well as the local codes and regulations or authorities having jurisdiction.
- C. Single-Source Responsibility for Wood Ceiling System: Obtain each type of Lift & Lock Wood Tiles from a single fabricator, with in-house Shop Drawing capabilities, in-house assembly and finishing capabilities, and with resources to provide products of consistent quality in appearance and physical properties without delaying the project.
- D. Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying project.
- E. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
  - 1. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Delivery & Unloading: Coordinate crate sizes, weights, unloading options, and delivery schedule with manufacturer prior to fabrication. Deliver wood panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other mistreatment.
- B. Acclimatization: Before installing wood panels, permit them to reach room temperature and a stabilized moisture content (at least 72 hours) per AWI standards.
- C. Handle Lift & Lock Wood Tiles carefully to avoid chipping edges or damaging units in any way.
- D. Protection:
  - 1. Personnel: Follow good safety and industrial hygiene practices during handling and installing of all products and systems, with personnel to take necessary precautions and wear appropriate protective equipment as needed. Read related literature for important information on products before installation. Contractor to be solely responsible for all personal safety issues during and subsequent to installation; architect, specifier, owner, and manufacturer will rely on contractor's performance in such regard.
  - 2. Existing completed work: Protect completed work above suspension system from damage during installation of suspension system components.

## 1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not install wood panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## 1.12 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lift & Lock Wood Tiles: Furnish quantity of full-size units equal to 2.0 percent of amount installed.
  - 2. Suspension System Components: Furnish quantity of each component equal to 2.0 percent of amount installed.
- B. Warranties: Provide owner with a (1) year warranty for material and workmanship on all installed products.
  - 1. Manufacturers: All materials, wood ceiling and grid, shall be warranted for (1) one year for material and workmanship.
  - 2. Installer: All work shall be warranted for (1) year from final acceptance of completed work.

# PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design seismic restraints and attachment devices.
- B. Structural Performance: Wood panel ceilings shall withstand the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of ceiling pans; or permanent damage to fasteners and anchors:
  - 1. Seismic Criteria: Provide wood panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
    - a. ASCE/SEI 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

- D. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class C materials.
  - 2. Smoke-Developed Index: 450 or less.

# 2.2 LIFT & LOCK WOOD TILES AND SUSPENSION SYSTEM

- A. General: The following manufacturer is basis of design:
  - 1. 9Wood, Inc. (www.9wood.com): Lift & Lock Wood Tiles, Style 4300.
  - 2. Or equal, as prior approved by Architect.

# 2.3 LIFT & LOCK WOOD TILES

- A. Basis-of-Design Product: 9Wood, Inc. Wood Tiles Series 4000
  - 1. Wood Panels: 4300 Lift & Lock Wood Tiles, SKU 4324-48
    - a. Species: Doug Fir Solid, Vertical Grain.
    - b. Panel Size: 24" x 48"
    - c. Edge Profile: Edgeband.
    - d. Tile Reveal: 3/8".
    - e. Suspension Style: Lift & Lock Modular Suspension
    - f. Fire Rating: Class 1(A) Fire Rating.
    - g. Panel Sizes: Varies, see reflected ceiling plan.
    - h. Finish: Clear Satin Sheen Finish.
    - i. Acoustic Backer: None.
    - j. Perimeter Condition: Shadow Molding.

## 2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Metal T-Grid Suspension System: Provide standard interior Metal Heavy Duty 1 1/2" suspension T-Grid system using Main Runners, Cross-tees, Wall Angle or Shadow Moldings of types, structural classifications, and black finishes indicated and that comply with applicable ASTM C 635 requirements. Comply with all applicable seismic codes and ordinances.

- C. Attachment Devices: Size for 3 times the design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- D. Wire, Braces, Ties, Hanger Rods, Flat Hangers and Angle Hangers: Provide wires, rods and hangers that comply with applicable ASTM specifications.
- E. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. General: Examine substrates and structural framing to which ceilings attach or abut, with installer present, for compliance with requirements specified in this and other sections that affect ceiling installation and anchorage. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
- B. Layout: Measure each ceiling area and establish the layout of Lift & Lock Wood Tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and conform to the layout shown on reflected ceiling plans in accordance with wood ceiling manufacturer's approved Shop Drawings.

#### 3.3 INSTALLATION

- A. General: Install 9Wood, Inc. Interior Lift & Lock Wood Tiles, Style 4300 to comply with manufacturer's instructions and CISCA "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard

suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

- 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
- 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
- 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
- 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
- 8. Do not attach hangers to steel deck tabs.
- 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
- 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
- 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- D. Installation of Metal T-Bar Grid: Install, align, brace, tie-off, mount, handle interferences, and space suspension T-Grid in accordance with suspension manufacturer's instructions and in compliance with all local codes and regulations.
- E. Installation of Lift & Lock Wood Tiles, Style 4300: Install Wood Tile ceiling panels in accordance with manufacturer's installation instructions and in compliance with all local codes and regulations. Install with undamaged edges and fitted accurately to suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit, as required.
- F. Suspension Runners: Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members. Install number and use on-center spacing per wood ceiling manufacturer's instructions, as indicated on approved Shop Drawings and in compliance with all local codes.

# 3.4 CLEANING

A. General: Clean exposed wood surfaces of 9Wood, Inc. Lift & Lock Wood Tiles, Style 4300. Comply with manufacturer's instructions for cleaning and touchup of minor finish damage. Remove and replace wood ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095430

# SECTION 096466 - WOOD ATHLETIC FLOORING

# PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes wood athletic flooring.
- B. Related Sections:
  - 1. Section 033000 "Cast-in-Place Concrete" for concrete slab-on-grade subfloor to receive wood athletic flooring.
  - 2. Game Standard Inserts in Section 116623

# 1.3 REFERENCES

- A. DIN Performance Standard 18032 Part 2
- B. EN Performance Standard 14904 World Standard
- C. MFMA PUR Performance Uniformity Requirements
- D. FSC Forest Stewardship Council
- E. FIBA International Basketball Association
- F. MFMA Maple Flooring Manufacturers Association

# 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wood athletic flooring.
- B. Shop Drawings: For each type of floor assembly and accessory. Include plans, elevations, sections, details, and attachments to other work. Include the following:
  - 1. Expansion provisions and trim details.
  - 2. Layout, colors, widths, and dimensions of game lines and markers.
  - 3. Locations of floor inserts for athletic equipment installed through flooring assembly.

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- C. Samples for Initial Selection: Manufacturer's color charts showing colors and glosses available for the following:
  - 1. Floor finish.
  - 2. Game-line and marker paint.
- D. Samples for Verification: For each type of wood athletic flooring and accessory required; approximately 24 inches long and of same thickness and material indicated for the Work.
  - 1. Include sample sets showing the full range of normal color and texture variations expected in wood flooring.
  - 2. Include Sample sets showing finishes and game-line and marker paint colors applied to wood flooring.

# 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wood athletic flooring system.

#### 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wood athletic flooring and finish systems to include in maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced Installer who has completed wood athletic flooring installations similar in material, design, and extent to that indicated for this Project and whose work has resulted in installations with a record of successful in-service performance.
  - 1. Installer responsibilities include installation and field finishing of wood athletic flooring components and accessories, and application of game lines and markers.
- B. Maple Flooring: Comply with MFMA grading rules for species, grade, and cut.
  - 1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.
- C. Performance Testing
  - 1. Flooring system shall have been independently tested to the International Standards: DIN 18032, Part 2, EN 14904 or MFMA PUR.
  - 2. FIBA International Standards.
  - 3. Independent DIN testing laboratory must be recognized by the MFMA and test to all the required standards of the DIN testing methodologies.

- 4. Independent DIN testing laboratory shall have Scientific Body Membership in the International Association of Sports Surface Sciences (ISSS).
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. To set quality standards for installation, install mockup of floor area as shown on Drawings.
  - 2. Prepare finished mockup of floor area as shown on Drawings to set quality standards for sanding and application of field finishes and game lines and markers.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

# 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver assembly materials in unopened cartons or bundles.
- B. Protect wood from exposure to moisture. Do not deliver wood components until after concrete, masonry, plaster, ceramic tile, and similar wet work is complete and dry.
- C. Store wood components in a dry, warm, well-ventilated, weathertight location and in a horizontal position.

# 1.9 FIELD CONDITIONS

- A. Conditioning period begins not less than seven days before wood athletic flooring installation, is continuous through installation, and continues not less than seven days after installation.
  - 1. Environmental Conditioning: Maintain an ambient temperature between 65 and 75 deg F (18 and 24 deg C) and relative humidity planned for building occupants, but not less than 35 percent or more than 50 percent, in spaces to receive wood athletic flooring during the conditioning period.
  - 2. Wood Conditioning: Move wood components into spaces where they will be installed, no later than beginning of the conditioning period.
    - a. Do not install wood athletic flooring until wood components adjust to relative humidity of, and are at same temperature as, spaces where they are to be installed.
    - b. Open sealed packages to allow wood components to acclimatize immediately on moving wood components into spaces in which they will be installed.
- B. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
- C. Install wood athletic flooring after other finishing operations, including painting, have been completed.

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# 1.10 COORDINATION

A. Coordinate layout and installation of wood athletic flooring systems with floor inserts for gymnasium equipment.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Robbins Biocushion Classic floor system manufactured by Robbins Sports Surfaces or comparable product by one of the following:
  - 1. Action Floor Systems, LLC.
  - 2. Connor Floor; Subsidiary of Connor Sport Court International.
  - 3. Horner Flooring Company, Inc.
  - 4. Mondo.
  - 5. Aacer Flooring, LLC.
  - 6. WD Flooring, LLC.

#### 2.2 DESCRIPTION

- A. System Type: Floating.
- B. Overall System Height:
  - 1. 2-1/8 inches (54 mm)

#### 2.3 FLOORING MATERIALS

- A. Resilient Pads: 7/16" (11 mm) EcoDin pads.
- B. Subfloor:
  - 1. Two (2) layers of 1/2" APA-rated plywood sheathing. Exposure 1. No OSB or Aspen plywood can be substituted.
  - 2. FSC Certified Subfloor shall be certified by the Forest Stewardship Council.

#### C. Flooring:

- 1. 25/32" x 2-1/4", 2nd and Better grade, Northern Hard Maple flooring, TGEM, MFMKA grade marked and stamped as manufactured by Aacer Flooring.
- 2. FSC Certified Maple shall be certified by the Forest Stewardship Council.

#### 2.4 FASTENERS

A. Flooring: 2" barbed cleats.

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B. Subfloor: 1" coated staples.

## 2.5 FINISHES

- A. Floor-Finish System: System of compatible components recommended in writing by flooring manufacturer, and MFMA approved.
  - 1. Floor-Sealer Formulation: Pliable, penetrating type. MFMA Group 1, Sealers.
  - 2. Finish-Coat Formulation: Formulated for gloss finish indicated and multicoat application.
  - 3. Game-Line and Marker Paint: Industrial enamel compatible with finish coats and recommended in writing by manufacturers of finish coats, and paint for this use.
    - a. Colors: As indicated on Drawings.
  - 4. VOC Content: Products shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Floor Sealers and Finish Coats: VOC content of not more than 350 g/L.
    - b. Game-Line and Marker Paint: VOC content of not more than 150 g/L.

## 2.6 ACCESSORIES

- A. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than 6 mils (0.15 mm) thick.
- B. Resilient Wall Base: Heavy-duty, molded, vented, rubber or vinyl cove base; 4 by 3 by 48 inches (100 by 75 by 1200 mm); with premolded outside corners.
  - 1. Color: Black.
- C. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood athletic flooring manufacturer.
- D. Adhesives: Manufacturer's standard for application indicated that has a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of wood athletic flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Concrete Slabs: Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

- 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.
  - a. Perform anhydrous calcium chloride test per ASTM F 1869, as follows:
    - 1) Proceed with installation only after substrates have maximum moisturevapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
  - b. Perform plastic sheet test, ASTM D 4263. Proceed with installation only after testing indicates absence of moisture in substrates.
    - 1) Proceed with installation only if there is no evidence of condensation or clouding in 24 hours.
  - c. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

## 3.2 PREPARATION

- A. Grind high spots and fill low spots on concrete substrates to produce a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10-foot (3-m) straight edge.
  - 1. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- B. Remove coatings including curing compounds and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone; use mechanical methods recommended by manufacturer. Do not use solvents.
- C. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.3 INSTALLATION

- A. General: Comply with wood athletic flooring manufacturer's written instructions, but not less than written recommendations of MFMA applicable to flooring type indicated.
- B. Pattern: Lay flooring parallel with long dimension of space to be floored unless otherwise indicated.
- C. Expansion Spaces: Provide as indicated, but not less than that required by manufacturer's written instructions and MFMA's written recommendations at walls and other obstructions, and at interruptions and terminations of flooring.
  - 1. Cover expansion spaces with base molding, trim, and saddles, as indicated on Drawings.

- D. Vapor Retarder: Cover entire slab area beneath wood flooring. Install with joints lapped a minimum of 6 inches (150 mm) and sealed.
- E. Underlayment: Install perpendicular to direction of flooring, staggering end joints in adjacent rows.

## 3.4 SANDING AND FINISHING

- A. Allow installed flooring to acclimate to ambient conditions before sanding.
- B. Follow applicable recommendations in MFMA's "Industry Recommendations for Sanding, Sealing, Court Lining, Finishing, and Resurfacing of Maple Gym Floors."
- C. Machine sand with coarse, medium, and fine grades of sandpaper to achieve a level, smooth, uniform surface without ridges or cups. Remove sanding dust by tack or vacuum.
- D. Finish: Apply seal and finish coats of finish system according to finish manufacturer's written instructions. Provide no fewer than four coats total and no fewer than two finish coats.
  - 1. Water-Based Finishes: Use finishing methods recommended by finish manufacturer to reduce grain raise and sidebonding effect.
  - 2. Game-Line and Marker Paint: Apply game-line and marker paint between final seal coat and first finish coat according to paint manufacturer's written instructions.
    - a. Mask flooring at game lines and markers, and apply paint to produce lines and markers with sharp edges.
    - b. Where game lines cross, break minor game line at intersection; do not overlap lines.
    - c. Apply game lines and markers in widths and colors according to requirements indicated on Drawings.
    - d. Apply finish coats after game-line and marker paint is fully cured.

# 3.5 **PROTECTION**

- A. Protect wood athletic flooring during remainder of construction period to allow finish to cure and to ensure that flooring and finish are without damage or deterioration at time of Substantial Completion.
  - 1. Do not cover flooring after finishing until finish reaches full cure and not before seven days after applying last finish coat.
  - 2. Do not move heavy and sharp objects directly over flooring. Protect fully cured floor finishes and surfaces with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

## END OF SECTION 096466

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Resilient base.
  - 2. Resilient molding accessories.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 4 inches (300 mm) long.
- C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

# 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

## 1.5 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Provide products with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Critical Radiant Flux: 0.45 watts per sq. cm or more per ASTM E 648.
  - 2. Smoke Density: Less than 450 per ASTM E 662.

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## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

## 1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than [95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

# PART 2 - PRODUCTS

## 2.1 RESILIENT WALL BASE (RB-1)

- A. Products: Basis-of-Design products from Johnsonite, Inc. Ecolibrium or comparable product by one of the following:
  - 1. Roppe Corporation, USA.
  - 2. VPI Corporation
- B. Product Standard: ASTM F 1861
  - 1. Group: I (solid, homogeneous).
  - 2. Meet or exceed ASTM E 84/NFPA 225 Class A flame spread index, less than 450 smoke density.
  - 3. Style:
    - a. Style B, Cove
- C. Thickness: 0.125 inch (3.2 mm
- D. Height: 4 inches (102 mm.
- E. Lengths: Coils in manufacturer's standard length.

- F. Outside Corners: Preformed.
- G. Inside Corners: Job formed.
- H. Colors: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.

#### 2.2 RUBBER MOLDING ACCESSORY

- A. Products: Basis-of-Design products from Johnsonite, Inc. Ecolibrium or comparable product by one of the following:
  - 1. Roppe Corporation, USA.
  - 2. VPI Corporation
- B. Description: Rubber carpet edge for glue-down applications reducer strip for resilient flooring .
- C. Profile and Dimensions: As indicated or as scheduled below.
  - 1. Carpet edge for glue down applications: Johnsonite profile EG-XX-H
  - 2. Reducer strip for resilient flooring: Johnsonite profile # SSR-XX-D
- D. Locations: At floor finish transitions.
- E. Colors and Patterns: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.

## 2.3 INSTALLATION MATERIALS

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

#### PART 3 - EXECUTION

# 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

# 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than **10** pH.
  - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
    - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are the same temperature as the space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

## 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
    - a. Cope corners to minimize open joints.

# 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
  - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  - 2. Tightly adhere to substrates throughout length of each piece.
  - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

# 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum horizontal surfaces thoroughly.
  - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

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END OF SECTION 096513

## SECTION 098433 - SOUND-ABSORBING WALL UNITS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
  - 1. Sound-absorbing wall panels.

#### 1.3 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include fabric facing, panel edge, core material, and mounting indicated.
- B. WSSP Submittals: For inclusion in the Contractor's WSSP Notebook, provide documentation verifying compliance with the following WSSP credits:
  - 1. M2.1: Recycled Content
  - 2. M2.5: Regional / Local Materials.
  - 3. IEQ3.1: Low-emitting interior finishes.
- C. Shop Drawings: For unit assembly and installation.
  - 1. Include plans, elevations, sections, and mounting devices and details.
  - 2. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
  - 3. Include details at cutouts and penetrations for other work.
  - 4. Include direction of fabric weave and pattern matching.
- D. Samples for Initial Selection: For each type of fabric facing.

- 1. Include Samples of hardware and accessories involving color or finish selection.
- E. Samples for Verification: For the following products:
  - 1. Fabric: Full-width by approximately 36-inch- (900-mm-) long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
  - 2. Panel Edge: 12-inch- (300-mm-) long Sample(s) showing each edge profile, corner, and finish.
  - 3. Core Material: 12-inch- (300-mm-) square Sample at corner.
  - 4. Mounting Devices: Full-size Samples.
  - 5. Assembled Panels: Approximately 36 by 36 inches (900 by 900 mm), including joints and mounting methods.

# 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Electrical outlets, switches, and thermostats.
  - 2. Items penetrating or covered by units including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Alarms.
    - e. Sprinklers.
    - f. Access panels.
  - 3. Show operation of hinged and sliding components covered by or adjacent to units.
- B. Product Certificates: For each type of unit.
- C. Sample Warranty: For manufacturer's special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but no fewer than 10 sq. yd. (9 sq. m), full width of bolt.
- 2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices, including unopened adhesives.

# 1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.
  - 1. Build mockup of typical wall area 48 inches (1200 mm) wide by full height. Include intersection of wall and ceiling, corners, and perimeters.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

# 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

# 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wetwork in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

#### 1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to the following:
  - a. Acoustical performance.
  - b. Fabric sagging, distorting, or releasing from panel edge.
  - c. Warping of core.
- 2. Warranty Period: Two years.

## PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall units specified in this Section and ceiling units specified in Section 098436 "Sound-Absorbing Ceiling Units from single source from single manufacturer.
- B. Basis-of-Design Product: Colorsonix manufactured by MBI Products Company, Inc as indicated on drawings or a comparable product by one of the following:
  - 1. Acoustical Solutions, Inc.
  - 2. Armstrong World Industries
  - 3. Decoustics Limited; a Saint Gobain company
  - 4. Sound Concepts

## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

## 2.3 SOUND-ABSORBING WALL UNITS

A. Sound-Absorbing Wall Panel (SAW-1, SAW-2, SAW-3): Manufacturer's standard panel construction consisting of facing material stretched over front face of edge-framed core and bonded or attached to edges and back of frame.

- 1. Basis-of-Design Product: 1.5 Inch Thick Colorsonix Fabric Wrapped Panels.
- 2. Panel Shape: Flat.
- 3. Mounting: Edge mounted with splines secured to substrate.
  - a. Finish Color at Exposed Edges: Match color of facing material.
- 4. Mounting: Back mounted with manufacturer's standard metal clips or bar hangers, secured to substrate.
- 5. Core: 6-7# Fiberglass.
- 6. Retain "Core-Face Layer" Subparagraph below if different face layer is required for the core material to make the units impact resistant, tackable, or both.
- 7. First option in "Edge Construction" Subparagraph below is most common and is used with glass- and mineral-fiber board cores. Last three options are sometimes used for panels with facing material stretched over front face of edge-framed core.
- 8. Edge Construction: Chemically Hardened
- 9. Edge Profile: Square.
- 10. Corner Detail in Elevation: Square with continuous edge profile indicated.
- 11. Reveals between Panels: Recessed reveals as selected by Architect from manufacturer's full range.
- 12. Facing Material: As indicated on Drawings.
- 13. Acoustical Performance: Sound absorption NRC 0.90 to 1.10 according to ASTM C 423 for Type A mounting according to ASTM E 795.
- 14. Panel Width: As indicated on Drawings.
- 15. Panel Height: As indicated on Drawings.

# 2.4 MATERIALS

- A. Core Materials:
  - 1. 6-7# Fiberglass
  - 2. Metal Clips or Bar Hangers: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.

# 2.5 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Edge Hardening: For glass-fiber board cores, chemically harden core edges and areas of core where mounting devices are attached.
- C. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.

- D. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
  - 1. Square Corners: Tailor corners. Heat-seal vinyl fabric seams at corners.
  - 2. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.
- E. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:
  - 1. Thickness.
  - 2. Edge straightness.
  - 3. Overall length and width.
  - 4. Squareness from corner to corner.
  - 5. Chords, radii, and diameters.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

# 3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain with adjacent units.

## 3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus or minus 1/16 inch (1.6 mm) in 48 inches (1200 mm), noncumulative.
- B. Variation of Joint Width: Not more than 1/16-inch (1.6-mm) variation from reveal line in 48 inches (1200 mm), noncumulative.

# ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON

## 3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 098433

SECTION 099113 - EXTERIOR PAINTING

## PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates.
- B. Related Requirements:
  - 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
  - 2. Section 099123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

#### 1.3 DEFINITIONS

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

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.

#### EXTERIOR PAINTING

- 2. Step coats on Samples to show each coat required for system.
- 3. Label each coat of each Sample.
- 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 3. VOC content.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

# 1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

#### PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by Sherwin Williams or comparable products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. ICI Paints.
  - 3. Kelly-Moore Paints.
  - 4. PPG Architectural Finishes, Inc.

# 2.2 PAINT, GENERAL

A. Material Compatibility:

- 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range.

# 2.3 METAL PRIMERS

- A. Primer, Water Based, Anti-Corrosive for Metal:
  - 1. S-W Pro Industrial ProCryl Universal Primer B66A310 (99 g/l VOC).

# 2.4 WATER-BASED PAINTS

- A. Light Industrial Coating, Exterior, Water Based, Semi-Gloss (Gloss Level 5):
  - 1. S-W Sher-Cryl High Performance Acrylic Semi-Gloss Coating B66W00351 (g/L VOC).

# 2.5 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
  - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

# PART 3 - EXECUTION

# 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

- 1. Concrete: 12 percent.
- 2. Fiber-Cement Board: 12 percent.
- 3. Masonry (Clay and CMU): 12 percent.
- 4. Wood: 15 percent.
- 5. Portland Cement Plaster: 12 percent.
- 6. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

# 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Cement Composition Siding/Panels: Remove all surface contamination by washing with an appropriate cleaner, rinse thoroughly and allow to dry. Existing peeled or checked paint should be scraped and sanded to a sound surface. Pressure clean, if needed, with a minimum of 2100 psi pressure to remove all dirt, dust, grease, oil, loose particles, laitance, foreign material, and peeling or defective coatings. Allow the surface to dry thoroughly. The pH of the surface should be between 6 and 9, unless the products are designed to be used in high pH environments.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

#### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
  - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  - 4. Paint entire exposed surface of window frames and sashes.
  - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

# 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

#### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

# 3.6 EXTERIOR PAINTING SCHEDULE

- A. Metal Steel Substrates:
  - 1. Water-Based Light Industrial Coating System:
    - a. Prime Coat: Primer, anti-corrosive for metal. S-W Pro Industrial Pro -Cryl Universal Primer B66W00310 (99 g/L VOC).
    - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5). S-W Industrial & Marine Sher-Cryl HPA Semi-Gloss B66W351 (199 g/L VOC)
- B. Galvanized-Metal Substrates:
  - 1. Water-Based Light Industrial Coating System:
    - a. Prime Coat: Primer, galvanized, water based. S-W Pro Industrial Pro -Cryl Universal Primer B66W00310 (99 g/L VOC).
    - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5). S-W Industrial & Marine Sher-Cryl HPA Semi-Gloss B66W351 (199 g/L VOC)

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

## PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Steel and iron.
  - 2. Gypsum board.

# 1.3 DEFINITIONS

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

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.

## INTERIOR PAINTING

- 2. Apply coats on Samples in steps to show each coat required for system.
- 3. Label each coat of each Sample.
- 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

## 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

#### 1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

# 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

## 1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis for design: Benjamin Moore & Co
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. ICI Paints.
  - 3. Miller Paint.
  - 4. PPG Architectural Finishes, Inc.
  - 5. Pratt & Lambert.
  - 6. Rodda Paint Co.
  - 7. Sherwin-Williams Company (The).
- C. Products: Subject to compliance with requirements, provide product listed in other Part 2 articles for the paint category indicated..

#### 2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As indicated in a color schedule.

## 2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

#### INTERIOR PAINTING
- 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
- 2. Testing agency will perform tests for compliance with product requirements.
- 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

- 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

# 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed in occupied spaces:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - h. Other items as directed by Architect.
  - 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

# 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

## 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

## 3.6 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

- 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
  - a. Prime Coat: Quick-drying alkyd metal primer.
  - b. Intermediate Coat: Interior latex matching topcoat.
  - c. Topcoat: Interior latex (semigloss).
- B. Galvanized-Metal Substrates:
  - 1. Latex System: MPI INT 5.3A.
    - a. Prime Coat: Cementitious galvanized-metal primer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (semigloss).
- C. Gypsum Board Substrates:
  - 1. Latex System: MPI INT 9.2A.
    - a. Prime Coat: Interior latex primer/sealer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (eggshell).

END OF SECTION 099123

SECTION 101200 - DISPLAY CASES

#### 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. Illuminated display cases.
- B. Related Sections:
  - 1. Division 10 Section "Visual Display Surfaces" for bulletin board material.
  - 2. Division 26 Sections for wiring and other electrical work associated with illuminated display cases.

#### 1.3 DEFINITIONS

- A. Bulletin Board: Tackable visual display surface enclosed in a display case.
- B. Display Case: Glazed cabinet with visual display surface background and adjustable shelves.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for display cases.
- B. Shop Drawings: For display cases. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show location of seams and joints in visual display surfaces.
  - 2. Include sections of typical trim members.
  - 3. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes, and as follows:
  - 1. Actual sections of visual display surfaces.
- D. Qualification Data: For qualified professional engineer.

#### DISPLAY CASES

E. Maintenance Data: For visual display surfaces, operating hardware, and illuminated units to include in maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain display cases from single source from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install display cases until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of openings for display cases by field measurements before fabrication.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Hardboard: ANSI A135.4, tempered.
- B. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.
- C. Vinyl Fabric: FS CCC-W-408D, Type II, burlap weave; weighing not less than 13 oz./sq. yd. (440 g/sq. m); with flame-spread index of 25 or less when tested according to ASTM E 84.
- D. Extruded-Aluminum Bars and Shapes: ASTM B 221 (ASTM B 221M), Alloy 6063.
- E. Aluminum Tubing: ASTM B 429, Alloy 6063.
- F. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering, and 6 mm thick unless otherwise indicated.
- G. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for

exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.

# 2.2 BULLETIN BOARD ASSEMBLIES

A. Linoleum resilient tackable surface material as specified in Division 10 section "Visual Display Surfaces".

## 2.3 DISPLAY CASE

- A. Basis of Design Product: Subject to compliance with requirements, provide Claridge Products and Equipment, Inc.; 390 series or a comparable product by one of the following:
  - 1. A-1 Visual Systems.
  - 2. AARCO Products, Inc.
  - 3. ADP Lemco, Inc.
  - 4. Best-Rite Manufacturing.
  - 5. Ghent Manufacturing, Inc.
  - 6. Nelson-Harkins Industries.
- B. Recessed Cabinet: Factory-fabricated cabinet; with tackboard assembly on back inside surface, operable glazed doors at front, and trim on face to cover edge of recessed opening.
  - 1. Cabinet Box: Extruded aluminum.
  - 2. Cabinet Frame and Trim: Aluminum.
  - 3. Aluminum Finish: Baked Enamel or Powder Coat, color to be selected from manufacturer's full range.
- C. Glazed Sliding Doors: Tempered glass; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.
  - 1. Thickness: Not less than 6 mm thick.
  - 2. Number of Doors: As indicated.
- D. Shelves: 6-mm-thick tempered glass; supported on adjustable shelf standards and supports.
  - 1. Shelf Width: Top shelf, 6 inches (150 mm); lower shelves, 12 inches (300 mm).
  - 2. Number of Shelves: Three.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112; recess mounted in rear surface. Provide standards full height of display case.
- F. Tack Surface: Linoleum resilient tackable surface material.
- G. Illumination System: Concealed top-lighting system consisting of fluorescent-strip fixtures. Include lamps and internal wiring with single concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.

- 1. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label.
- H. Width: As indicated.
- I. Height: As indicated.
- J. Depth: As indicated.

#### 2.4 FABRICATION

- A. Fabricate display cases to requirements indicated for dimensions, design, and thickness and finish of materials.
- B. Use metals and shapes of thickness and reinforcing to produce flat surfaces, free of oil-canning, and to impart strength for size, design, and application indicated.
- C. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.
- D. Fabricate exterior units with vents to permit evaporation of moisture trapped inside.
- E. Fabricate shelf standards plumb and at heights to align shelf brackets for level shelves.

#### 2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### 2.6 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color: Medium Bronze.

## PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power system to verify actual locations of connections before installation of illuminated units.
- C. Examine walls and partitions for suitable framing depth if recessed units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

A. Prepare recesses for display cases as required by type and size of unit.

#### 3.3 INSTALLATION

- A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Recessed Display Cases: Attach units to wall framing with fasteners at not more than 16 inches (400 mm) o.c. Attach aluminum trim over edges of recessed display cases and conceal grounds and clips. Attach trim with fasteners at not more than 24 inches (600 mm) o.c.
- C. Comply with requirements in Division 26 for connecting illuminated display cases.
  - 1. After installation is complete, install new fluorescent lamps.
- D. Install display case shelving level and straight.

### 3.4 ADJUSTING AND CLEANING

- A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.

## END OF SECTION 101200

#### DISPLAY CASES

### SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cutout dimensional characters.

## 1.3 COORDINATION

A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For dimensional letter signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  - 3. Show message list, typestyles, graphic elements, and layout for each sign
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Dimensional Characters: Half-size Sample of dimensional character.
  - 2. Exposed Accessories: Full-size Sample of each accessory type.
- D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

# 1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

### DIMENSIONAL LETTER SIGNAGE

### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.
- 1.7 QUALITY ASSURANCE
  - A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

#### 1.8 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

### 1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Separation or delamination of sheet materials and components.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

# 2.1 DIMENSIONAL CHARACTERS

- A. Cutout Characters: Characters with uniform faces, square cut, sharp corners, and precisely formed lines and profiles, and as follows:
  - 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. Basis of design: ASI LPS Series Cut Metal Letters.
    - b. A.R.K. Ramos.
    - c. ACE Sign Systems, Inc.
    - d. APCO Graphics, Inc.
    - e. Diskey Architectural Signage Inc.
    - f. Gemini Incorporated.
    - g. Matthews International Corporation; Bronze Division.
    - h. Metal Arts.

- i. Metallic Arts.
- j. Southwell Company (The).
- 2. Character Material: Cast aluminum.
- 3. Character Height: As indicated.
- 4. Thickness: Manufacturer's standard for size of character.
- 5. Finishes:
  - a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
- 6. Mounting: Projecting studs.
- 7. Typeface: As Indicated.

# 2.2 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

## 2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
  - 1. Use concealed fasteners and anchors unless indicated to be exposed.
  - 2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
  - 3. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
  - 4. Sign Mounting Fasteners:
    - a. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

#### 2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
  - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

- 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
- 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
- 5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

# 2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

## 2.6 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

- 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
- 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
  - 1. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

### 3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

# SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Requirements:
  - 1. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

#### 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 toilet compartments.
- B. Shop Drawings: For toilet compartments.
  - 1. Include plans, elevations, sections, details, and attachment details.
  - 2. Show locations of cutouts for compartment-mounted toilet accessories.
  - 3. Show locations of centerlines of toilet fixtures.
  - 4. Show locations of floor drains.
- C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
  - 1. Each type of material, color, and finish required for toilet compartments, prepared on 6inch- (152-mm-) square Samples of same thickness and material indicated for Work.
  - 2. Each type of hardware and accessory.
- D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

### 1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment.

### 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

### 1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

### PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

### 2.2 PHENOLIC-CORE TOILET COMPARMENTS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
  - 1. Basis of design: Bradley Solid Phenolic Core Partition Series 400.
  - 2. Accurate Partitions Corp.; ASI Group.
  - 3. <u>American Sanitary Partition Corporation</u>.
  - 4. <u>Bobrick Washroom Equipment, Inc</u>.
- B. Toilet-Enclosure Style: Floor anchored.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.

- E. Pilaster: Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- F. Brackets (Fittings):
  - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel or aluminum.
- G. Phenolic-Panel Finish:
  - 1. Facing Sheet Finish: One color and pattern in each room.
  - 2. Color and Pattern: As selected by Architect from manufacturer's full range, with manufacturer's standard.
  - 3. Edge Color: Manufacturer's standard.

### 2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.
  - 1. Material: Clear-anodized aluminum or Stainless steel.
  - 2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door.
  - 3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
  - 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
  - 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
  - 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

## 2.4 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).
- C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

D. Stainless-Steel Castings: ASTM A 743/A 743M.

#### 2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide inswinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

### PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
  - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch (13 mm).
    - b. Panels and Walls: 1 inch (25 mm).
  - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
    - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.

- B. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

## 3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113.17

### SECTION 102600 - WALL AND DOOR PROTECTION

### 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. Corner guards.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
  - 1. Include plans, elevations, sections, and attachment details.
- C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
  - 1. Corner Guards: 12 inches (300 mm) long. Include example top caps.

## 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
  - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

## 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Corner-Guard Covers: Full-size (4') corner guards. Qty: 4.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the project site in unopened original factory packaging clearly labeled to show manufacturer.
- B. Store materials in original, undamaged packaging in a cool, dry place out of direct sunlight and exposure to the elements. A minimum room temperature of 40°F (4°C) and a maximum of 100°F (38°C) should be maintained.
- C. Material must be stored flat.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and doorprotection units that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
    - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.

### 2.3 MATERIALS

- A. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.
  - 1. Use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Gypsum Board and Panel Adhesives: 50 g/L.
    - b. Multipurpose Construction Adhesives: 70 g/L.
    - c. Contact Adhesive: 250 g/L.

### 2.4 CORNER GUARDS

- A. Surface-Mounted, Resilient Plastic Corner Guards: Provide Extruded material should be high impact Acrovyn 4000 with shadow grain texture. Chemical and stain resistance should be per ASTM D543 standards as established by the manufacturer. Colors to be indicated in the finish schedule from one of manufacturer's standard color range:
  - 1. Basis of Design Manufacturer: Construction Specialties, Inc., 1. Model VA-250N with  $2-\frac{1}{2}$ " (64mm) legs self-adhesive tape backing.
  - 2. InPro Corportaion
  - 3. IPC Door and Wall Protection Systems; Division of InPro Corporation.
  - 4. Korogard Wall Protection Systems; Division of RJF International Corporation.
  - 5. Pawling Corporation.
  - 6. Tepromark International, Inc.
- B. Requirements:
  - 1. Match height of wainscot or maximum of 4'-0" above finished floor unless noted otherwise.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
  - 1. Do not proceed until unsatisfactory conditions have been corrected.

## 3.2 Preparation

A. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.

- B. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.
- 3.3 Installation
  - A. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.
  - B. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.

### 3.4 Cleaning

- A. General: Immediately upon completion of installation, clean guards and accessories in accordance with manufacturer's recommended cleaning method.
- B. Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.
- 3.5 Protection
  - A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION 102600

## SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Public-use washroom accessories.
  - 2. Staff Only-use bathroom accessories.
  - 3. Custodial accessories.
- B. Related Requirements:
  - 1. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.

#### 1.3 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Include electrical characteristics.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated.
  - 2. Identify accessories using designations indicated.

## TOILET, BATH, AND LAUNDRY ACCESSORIES

### 1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

### 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

### 1.7 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, visible silver spoilage defects.
  - 2. Warranty Period: 15 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 OWNER-FURNISHED MATERIALS

- A. Owner-Furnished Materials to be installed by contractor:
  - 1. As indicated in Toilet Accessories Schedule and Large Scale Plans in drawings.

#### 2.2 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.

#### 2.3 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser (TTD):
  - 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. <u>AJW Architectural Products</u>.
    - b. <u>American Specialties, Inc</u>.
    - c. <u>Bobrick Washroom Equipment, Inc</u>.
    - d. <u>Bradley Corporation</u>.
    - e. <u>GAMCO Specialty Accessories; a division of Bobrick</u>.

- 2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
- 3. Mounting: Partition mounted, serving two adjacent toilet compartments and Surface mounted.
- 4. Operation: Noncontrol delivery with standard spindle.
- 5. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
- 6. Material and Finish: Stainless steel, No. 4 finish (satin).
- C. Grab Bar (GB):
  - 1. Basis-of-Design Product: Bobrick B-6806 Series
  - 2. Mounting: Flanges with concealed fasteners.
  - 3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
    - a. Finish: Smooth, No. 4 finish (satin).
  - 4. Outside Diameter: 1-1/2 inches (38 mm).
  - 5. Configuration and Length: As required to comply with Oregon Structural Specialty Code for locations indicated.
- D. Mirror Unit (MR):
  - 1. Basis-of-Design Product: Bobrick B-2908
  - 2. Frame: Stainless-steel angle, 0.05 inch (1.3 mm) thick.
    - a. Corners: Manufacturer's standard.
  - 3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
    - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
    - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
  - 4. Size: 24"x36".

#### 2.4 CUSTODIAL ACCESSORIES

- A. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
  - 1. A & J Washroom Accessories, Inc.
  - 2. American Specialties, Inc.
  - 3. Bobrick Washroom Equipment, Inc.
  - 4. Bradley Corporation.
  - 5. General Accessory Manufacturing Co. (GAMCO).
- B. Mop and Broom Holder (MBH):

- 1. Basis-of-Design Product: Bobrick B-239
- 2. Description: Unit with shelf, hooks, and holders.
- 3. Length: 34 inches.
- 4. Hooks: Four.
- 5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
- 6. Material and Finish: Stainless steel, No. 4 finish (satin).
- 7. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.

# 2.5 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

## 2.6 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

## 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

## SECTION 104413 - FIRE EXTINGUISHER CABINETS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fire protection cabinets for the following:
    - a. Portable fire extinguishers.
- B. Related Sections:
  - 1. Section 104416 "Fire Extinguishers."

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
  - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Provide fastener types, sizes, quantities and spacing for each indicated substrate.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.
- B. Keys for cabinets Qty: 4.

## 1.5 QUALITY ASSURANCE

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

## 1.6 COORDINATION

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

# PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
  - 1. Sheet: ASTM B 209 (ASTM B 209M).
  - 2. Extruded Shapes: ASTM B 221 (ASTM B 221M).
- B. Break Glass: Clear annealed float glass, ASTM C 1036, Type I, Class 1, Quality q3, 1.5 mm thick, single strength.
- C. Fasteners: Corrosion resistant of necessary size, penetration, quantity, and spacing to rigidly mount cabinet to indicated substrate. Substrates will vary from location to location.

## 2.2 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Products: Subject to compliance with requirements, provide cabinets from one of the following:
    - a. J. L. Industries, Inc., a division of Activar Construction Products Group.
    - b. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
    - c. Larsen's Manufacturing Company.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Aluminum sheet.

- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation. Shall not extend more than 3-1/2" from wall finish for ADA purposes.
  - 1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- E. Cabinet Trim Material: Aluminum sheet.
- F. Door Material: Aluminum sheet.
- G. Door Style: Fully glazed panel with frame.
- H. Door Glazing: Break glass.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  - 1. Provide recessed door pull and friction latch.
  - 2. Provide manufacturer's standard hinge permitting door to open 180 degrees.
- J. Accessories:
  - 1. Door Lock: Cylinder lock, keyed alike to other cabinets.
  - 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate on cabinet.
    - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
      - 1) Location: Applied to cabinet door.
      - 2) Application Process: Decals.
      - 3) Lettering Color: Red.
      - 4) Orientation: Vertical.
- K. Finishes:
  - 1. Manufacturer's standard "white" baked-enamel paint for the following:
    - a. Exterior of cabinet, door, and trim except for those surfaces indicated to receive another finish.
    - b. Interior of cabinet and door.

## 2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

- 1. Weld joints and grind smooth.
- 2. Provide factory-drilled mounting holes.
- 3. Prepare doors and frames to receive locks.
- 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
  - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
  - 2. Fabricate door frames of one-piece construction with edges flanged.
  - 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

## 2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.5 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: White matte.

## PART 3 - EXECUTION

# 3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

# 3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated below:
  - 1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
  - 1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
  - 2. Provide inside latch and lock for break-glass panels.
- C. Identification: Apply decals at locations indicated.

### 3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factoryfinished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

## END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

### 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 portable, hand-carried.
- B. Related Sections:
  - 1. Section 104413 "Fire Extinguisher Cabinets."

# 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.

#### 1.4 QUALITY ASSURANCE

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

#### 1.5 COORDINATION

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

#### 1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:
  - a. Failure of hydrostatic test according to NFPA 10.
  - b. Faulty operation of valves or release levers.
- 2. Warranty Period: Six years from date of Substantial Completion.

#### PART 2 - PRODUCTS

#### 2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. J. L. Industries, Inc.; a division of Activar Construction Products Group.
    - b. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
    - c. Larsen's Manufacturing Company.
  - 2. Valves: Manufacturer's standard.
  - 3. Handles and Levers: Manufacturer's standard.
  - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type in Aluminum Container: UL-rated 2-A:10-B:C, 5-lb (2.3-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

## PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. General: Install fire extinguishers in compliance with requirements of authorities having jurisdiction.
- B. Quantity: Provide 8 fire extinguishers. 4 fire extinguishers shall be housed in semi-recessed fire extinguisher cabinets.

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C. Locations: Coordinate final locations with the authorities having jurisdiction.

END OF SECTION 104416
SECTION 105113 - METAL LOCKERS

# PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Athletic metal lockers.
  - 2. Locker benches.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.
- B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show locker trim and accessories.
  - 2. Include locker identification system and numbering sequence.
  - 3. Fasteners of each type, size, quantity and spacing as required to rigidly secure to each indicated substrate.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

# 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Full-size units of the following metal locker hardware items:

- a. Locks Quantity: same number as lockers (as indicated on the drawings) plus 5 ADA (see materials below).
- b. Hooks Quantity: same number as lockers (as indicated on the drawings).

# 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain metal lockers and accessories from single source from single manufacturer.
- C. Regulatory Requirements: Metal lockers and benches are to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities".

# 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.
- B. Deliver master and control keys and combination control charts to Owner.

#### 1.8 PROJECT CONDITIONS

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

# 1.9 COORDINATION

- A. Coordinate sizes and locations of bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.

- b. Faulty operation of latches and other door hardware.
- 2. Damage from deliberate destruction and vandalism is excluded.
- 3. Warranty Period for All-Welded Metal Lockers: 10 years from date of Substantial Completion.

#### PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.
- C. Expanded Metal: ASTM F 1267, Type II (flattened), Class I, 3/4-inch (19-mm) steel mesh, with at least 70 percent open area.
- D. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.
- E. Steel Tube: ASTM A 500, cold rolled.
- F. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- G. Anchors: Material, type, and size required for secure anchorage to each substrate.
  - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
  - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

### 2.2 ATHLETIC METAL LOCKERS

- A. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
  - 1. All-Welded, Athletic Metal Lockers: Basis of Design shall be Double Tier H lockers by Republic Storage Systems, LLC ALL WELDED or by one of the following that meet the basis of design:
    - a. <u>DeBourgh Mfg. Co</u> ALL WELDED.
    - b. <u>Lyon Workspace Products, LLC</u> ALL WELDED
    - c. Penco Products, Inc. ALL WELDED.
- B. Material: Cold-rolled steel sheet.
- C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

- 1. Tops and Bottoms: 0.060-inch (1.52-mm) nominal thickness, with single bend at edges.
- 2. Backs: 0.048-inch (1.21-mm) nominal thickness.
- 3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
- D. Unperforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.
- E. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet or 0.097-inch (2.45-mm) nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
  - 1. Cross Frames for Double-Tier Lockers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
- F. Reinforced Bottoms: Structural channels, formed from 0.060-inch (1.52-mm) nominal-thickness steel sheet; welded to front and rear of side-panel frames.
- G. Perforated Doors: One piece; fabricated from 16 gauge steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
  - 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
- H. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
  - 1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches (51 mm) high. Provide no fewer than three hinges for each door more than 42 inches (1067 mm) high.
- I. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.
  - 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in cylinder locks, or padlocks; positive automatic latching and prelocking.
    - a. Latch Hooks: Equip with two latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
    - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- J. Combination Padlocks: Provided by Owner.

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- K. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
  - 1. On Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
- L. Accessories:
  - 1. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
    - a. Closures: Vertical-end type.
  - 2. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
  - 3. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
  - 4. Boxed End Panels: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.
- M. Finish: Baked enamel.
  - 1. Color(s): As selected by Architect from manufacturer's full range.
- N. Size and Locations:
  - 1. Box size: There are 2 styles:
    - a. 12" and 15" wide. All are 30" tall, double stacked for a 60" tall unit.
    - b. Depth: 21" and as indicated on the drawings.
    - c. Quantity: as indicated on the drawings.

# 2.3 LOCKER BENCHES

- A. Provide bench units with overall assembly height of 17-1/2 inches (445 mm).
- B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.
  - Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick (241 mm wide by 32 mm thick).
    a. Length as indicated on plans.
  - 2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.
- C. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:
  - 1. Tubular Steel: 1-1/2-inch- (38-mm-) diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.
    - a. Color: Match metal lockers.

### 2.4 FABRICATION

A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

- 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
- 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
- C. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.
- D. Accessible Lockers: Fabricate as follows:
  - 1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.
  - 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.
- E. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- F. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch (9 mm) high.
- G. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.
- H. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
  - 1. Sloping-top corner fillers, mitered.
- I. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practical; finished to match lockers.
- J. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slipjoint filler angle formed to receive filler panel.
- K. Boxed End Panels: Fabricated with 1-inch- (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
  - 1. Provide one-piece panels for double-row (back-to-back) locker ends.
- L. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
  - 1. Provide one-piece panels for double-row (back-to-back) locker ends.

M. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

## 2.5 STEEL SHEET FINISHES

- A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
- B. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

### PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
  - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
  - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
- B. All-Welded Metal Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
  - 1. Attach hooks with at least two fasteners.
  - 2. Attach door locks on doors using security-type fasteners.
  - 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
    - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
    - b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

- 4. Attach recess trim to recessed metal lockers with concealed clips.
- 5. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
- 6. Attach sloping-top units to metal lockers, with closures at exposed ends.
- 7. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
- 8. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.
- D. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches (1830 mm) apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

### 3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

# END OF SECTION 105113

SECTION 116623 - ATHLETIC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Basketball equipment.
  - 2. Wall protection mats.
  - 3. Volleyball equipment.
  - 4. Floor plates and sleeves.

### 1.3 WORK BY OTHERS

A. The Contractor shall provide brace and support for the roof structure system against deflection or movement due to attachment of pulleys, winches, or other equipment in connection with the installation and operation of athletic equipment specified.

### 1.4 QUALITY ASSURANCE

- A. Acceptable manufacturers of athletic equipment are the following provided their products meet or exceed the quality and features of the specified products:
  - 1. Porter Equipment Company
  - 2. Draper Inc.
  - 3. Aalco Manufacturing Company
  - 4. Sports Specialties.

#### 1.5 WARRANTY

A. Submit manufacturer's written 20-year standard warranty providing for warranty against breakage of backboards.

# 1.6 SUBMITTALS

A. Submit product data for each type of equipment specified.

B. Submit installation drawings and details including wiring diagrams.

#### PART 2 - PRODUCTS

# 2.1 BASKETBALL EQUIPMENT

- A. Backstops shall be ceiling mounted, folding, with electric operators and superstructure, and shall be of the following type and manufacturer:
  - 1. Backstops: Draper Inc.
    - a. No. TF-20 Forward-Fold with A0136 glass banks with No. 5032 bolt-on safety padding, and A0581 Tube Tie Breakaway goals complete with mounting hardware and nylon anti-whip net.
    - b. Colors:
      - 1) As selected by Architect from manufacturer's full range of colors.
  - 2. Winches: No. 503085 remote control electric winch, 1 HP, 11.8 amp, capacitor type, 60 cycle, 110 V, single phase with automatic thermal overload protection. Provide one for each Main Court backboard unit. Provide with manufacturer's standard single gang keyswitch operation.
  - 3. Basketball backstop safety lock shall be furnished for each backstop and shall be No. 503029 Safety Strap as manufactured by Draper Inc.

# 2.2 WALL PROTECTION MATS (WP-1)

- A. Wall protection padding shall be covered with 14-ounce vinyl-coated polyester fabric with embossed pattern. Two-inch thick (3.5-lb. density) bonded foam filled panels shall be mounted on the wall as shown. Provide all devices as required for a complete installation. Panels shall be:
  - 1. Porter Athletics. Standard panels as shown.
    - a. Size: 2 ft. wide x 6 ft. high.
    - b. Color: As selected by Architect from manufacturer's full range of colors.
- B. Provide wall protection padding specified in Paragraph 2.2.A above where shown. Mount pads 3 inches above finished floor. Pads shall be cemented to 7/16-inch oriented strand backing board. Cover backing and board with vinyl-coated nylon fabric folded over edges and stapled on the back of the oriented strand backing board. Attach to wall using manufacturer's standard wall and panel attachment clips.
  - 1. Provide Wall Pad Cut-Out Trim Kit where access to receptacles and switches is required.

# 2.3 VOLLEYBALL EQUIPMENT

- A. Volleyball equipment shall be as scheduled below. Provide the necessary accessories and devices for a complete installation. Manufacturer of products below is Draper Inc.
  - 1. Standards: Model No. PVS Power Volleyball System as manufactured by Draper Inc. Post shall be telescoping type.
  - 2. Model No. 500004 Competition volleyball net as manufactured by Draper Inc. Net shall be 32 feet in length, 39-3/8 inches wide with black nylon mesh measuring approximately 4 inches by 4 inches square. Top hem of net shall be furnished with a 42 feet 6 inches long x 1/8 inch diameter 2000 lb. minimum breaking strength galvanized aircraft cable with a nylon coating to protect against fraying. Ends of nets shall have six 1-inch-wide polypropylene tension straps with buckles for providing additional tightening of net. Bottom of net shall be furnished with a 1/4-inch-diameter braided white nylon rope equipped with a spring loaded, pressure type rope tensioner.
  - 3. Judges Stand: Model No. 5013 by Draper Inc., with padding in color as selected by Architect from manufacturer's full range of colors.
  - 4. Storage Cart: Model No. 501016 by Draper Inc.
  - 5. Floor Sleeves: Provide cast-in-place 3-1/2-inch I.D. floor sleeves with choice of flush cover plates.

# PART 3 - EXECUTION

# 3.1 INSTALLATION

- A. Install athletic equipment in accordance with manufacturer's instructions and recommendations.
- B. Contractor shall verify steel elevation for mounting backstops and provide the appropriate lengths to insure the correct mounting height. Additional miscellaneous steel supports shall be included and installed as necessary for all items specified. Locate hinge point of main court backstops so that in a folded position the banks and structure clear the walls.
- C. Unpack and assemble volleyball equipment. Place in storage room ready for use.
- D. Install sleeves as recommended by manufacturer and as detailed.

END OF SECTION 116623

SECTION 126600 - TELESCOPING STANDS

## 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. Telescoping gym seating includes electrically operated systems of multiple-tiered seating rows comprising of seat, deck components, understructure that permits closing without requiring dismantling, into a nested configuration for storing or for moving purposes.

# 1.3 RELATED SECTIONS

- A. Section 116623 Athletic Equipment
- B. Division 26 Electrical Sections

#### 1.4 SYSTEM DESCRIPTION

- A. Bleacher system shall be comprised of multiple tiered, closed deck seating rows operating in a telescopic manner, incorporating the most economical quantity of sections while still complying with all loading requirements.
- B. The first moving row shall be secured with friction or mechanical locks. Other rows shall be mechanically locked, operable only upon unlocking and cycling the first row, quantity to be determined by bleacher manufacturer.
- C. Each bleacher row shall be comprised of risers, seat and deck components, and a complete set of supportive columns and braces.
- D. The telescopic bleacher shall incorporate a locking system permitting the use of one, several, or all rows, each locked in the extended position.

# 1.5 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design telescoping stands, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Telescoping stands shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ICC 300 and NFPA 102.

# 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for telescoping stands.
- B. Shop Drawings: For telescoping stands in both stacked and extended positions. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
  - 2. Graphics Layout Drawings: Graphics layout and pattern of contrasting or matching seat colors.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Seating: 6-inch- (150-mm-) square Sample of each seating material, color, and finish indicated.
- D. Delegated-Design Submittal: For telescoping stands indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

# 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Welding certificates.
- C. Product Certificates: For each type of fire-resistant construction, from manufacturer.

# 1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For telescoping stands to include in operation and maintenance manuals.
- B. Precautions for cleaning materials and methods that could be detrimental to telescoping stand finishes and performance.

# 1.9 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel," and AWS D1.3, "Structural Welding Code Sheet Steel."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Standard: Provide telescoping stands to comply with ICC 300 and NFPA 102.
- E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- F. Pre-installation Conference: Conduct conference at Project site.

### 1.10 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings and construction contiguous with telescoping stands by field measurements before fabrication. Verify locations of walls, columns, and other construction that will interface with operating telescoping stands.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Steel: Structural-Steel Shapes, Plates, and Bars: ASTM A 36/A 36M.
- B. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.
- C. Uncoated Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold-rolled commercial steel), or ASTM A 1011/A 1011M, Designation CS (hot-rolled commercial steel).
- D. Tubing: ASTM A 500, cold formed; ASTM A 501, hot formed; or ASTM A 513, mechanical.
- E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy as standard for manufacturer.
- F. Polyethylene Plastic: High-density polyethylene; molded, color-pigmented, textured, impact-resistant, structural formulation.

# 2.2 TELESCOPING STANDS (TS-1)

A. General: Operable systems of multiple-tiered seating on interconnected folding platforms that close, without being dismantled, into a nested stack for storing. Stand units permit opening and closing of adjacent rows, allow individual and collective rows to be locked open for use and close with vertical faces of upper skirts on the same vertical plane.

- B. Wall-Attached Telescoping Stands: Forward-folding system, in which the bleachers open in the forward direction by initially moving the front row away from the stack to the fully extended position and the rear of bleacher understructure, is permanently attached to wall construction.
- C. Basis-of-Design Product: Subject to compliance with requirements, provide closed deck telescopic bleachers "MAXAM26 Telescopic Gym Seat System" by Hussey Seating Company, U.S.A., North Berwick, Maine or comparable product by one of the following:
  - 1. Interkal, LLC
  - 2. Irwin Telescopic Seating Company.
  - 3. Kodiak Industries Ltd.
- D. Minimum Seat Count:
  - 1. 240
- E. Row Spacing: 24" row spacing.
- F. Row Rise: 11 5/8" rise
- G. Elevated Front Row: In height indicated on Drawings.
- H. Operation: Automatic, friction-type, integral power unit.
  - 1. Limit Switches: Automatically stop integral power system when telescoping stands reach fully opened or closed positions.
  - 2. Motion Monitor: Flashing light with self-contained warning horn, rated at 85 dB at 10 feet (3 m), mounted under telescoping seating for audio and visual warning during integral power operation.
  - 3. Transformer: As required to coordinate current characteristics of motor and control station with building electrical system.
  - 4. Remote Control: Portable pendant control system.

# 2.3 COMPONENTS

- A. Foot Level Aisles: Provide footrest level aisles at locations and sizes as shown on plans and approved shop drawings.
- B. Center Aisle: Provide a permanently attached self-storing aisle rail, which is designed to eliminate all labor associated with set up and storage of the aisle rails.
- C. Intermediate Steps: Provide manufacturers standard intermediate step as necessary per applicable code.
- D. Last Row Closure: Provide and install a properly supported, flush mounted board between the last row of the bleacher and the wall.
- E. Wheelchair-Accessible Seating:

- 1. Basis of Design: MAXXAM26 Flex Row: Provide first tier modular recoverable flexrows, per requirements of (ADA) Americans with Disability Act located as indicated. Each Flex-Row unit shall have an unlock handle for easy deployment if wheelchair or team seating access is needed. Unlock handle shall lock the bleacher seats into position when fully opened.
  - a. Provide a black full-surround steel skirting with no more than <sup>3</sup>/<sub>4</sub>" floor clearance for safety and improved aesthetics.
  - b. Provide a black injection molded end cap for the nose beam for safety and improved aesthetics.
  - c. Provide a mechanical positive lock when the Flex-Row system is in the open and used position.
  - d. Flex-Row modular units are designed to achieve multi-use front row seating to accommodate team seating, ADA requirements and facility specific requirements. Flex-Row units are available in modular units from 2 to 7 seats wide as well as full section widths.
- F. End Railing:
  - 1. Self-Storing End Rails: Provide steel self-storing 42" high self-storing end guard rails with tubular supports and vertical intermediate members to comply with all code requirements. Rails shall be fitted to each exposed bank end from third row and above with all steel to steel connections. Finish shall be polyester powder coat in color selected from mfr's standard color selection.
- G. Operation:
  - 1. Pendant Control: Provide pendant control style operation for the bleachers. Extension and retraction shall be accomplished by use of the pendant control plugged into a single receptacle. The receptacle shall be mounted at the first row.
- H. End Panels: Provide manufacturers standard end panels to close off the opening between end rails and the wall when the bleachers are stacked.
- I. Vinyl End Closure Curtain
  - 1. Provide closure curtains fabricated of vinyl-coated 14 oz. polyester fabric on open ends of telescopic seating. Curtains to be permanently attached to wall or rear closure panel and secured to individual rows of seating. Curtain to open with seating unit into taught secure configuration and fold automatically as seating unit closes.
  - 2. Colors/Finishes: As indicated in Color and Material Schedule on Drawings.

# 2.4 FABRICATION

- A. Continuous Wheel Channel:
  - 1. Wheel channels shall consist of a one piece formed steel channel welded to the base of a vertical column. Wheel channels accommodate 8 to 12 wheels per row for maximum

weight distribution and operating ease. The number of wheels increase as the number of rows increase.

- B. Wheels: 5" diameter with 1-1/4" non-marring soft rubber face with rounded edges designed to protect wood or synthetic floor. Provide 3/8" to 1/2" diameter axle for all wheels.
- C. Columns: Electrically welded closed rectangular steel tube, 2"x 3" minimum size, 14 gauge steel fitted with a rear welded gusset at the wheel channel.
- D. Row Interlocks: Join each row structure front to rear by means of two (2) interacting steel connections, plus automatic gravity row locks where Engineering determines they are required.
  - 1. Lower: Lower track guides shall be an external superslide rod to guarantee positive engagement of vertical supports without binding and assures smooth operation over uneven floor conditions.
  - 2. Upper: Upper track guides shall completely interlock adjacent understructure support. A welded stop to ensure correct extension of bleacher unit on deck support. Use of bolt and nut stops are not acceptable, due to risk of loosening.
- E. Diagonal Braces: Structural formed steel truss fitted to rows 4 and beyond. Bracing shall be attached to the rear riser at optimum locations to insure structural integrity. Bracing will be designed and shaped to support a minimum load of 1000 lbs. of both compression and tension forces created when the bleacher is loaded.
- F. Deck Supports: Shall be of structural steel, 11 gauge spaced not greater than 60" on center for maximum deck stiffness.
  - 1. Rollers: Every deck support not attached to a vertical post will have an integral nylon roller to avoid steel to steel friction points for more efficient operation.
- G. Decking: 5/8", AC grade clear-top-coated tongue and groove Southern Yellow Pine; or BC grade polyethylene-top-coated tongue and groove Douglas Fir plywood; both of interior type with exterior glue, 5-ply, all plies with plugged cross-bands, produced in accordance with National Bureau of Standards PS-1-97. Plywood shall be cut and installed with top, center and bottom ply grain-oriented from front of deck to rear of deck (nose beam to riser beam). Adjacent pieces shall be locked together with tongue and groove joint from front to rear of deck.
- H. Welds: All welds shall be made at the factory by welders that are AWS certified on the equipment and process used.
- I. Nose Beam: Shall be one-piece 13 gauge galvanized steel. 13 gauge steel is utilized for the necessary structural integrity to accommodate section lengths up to 26 feet.
- J. Rear Riser: Shall be one piece formed 14-gauge, grade 50, galvanized steel, with a continuous access joint to fully encapsulate footrest panel ease of cleaning and additional structural support. 14-guage roll formed steel is utilized for the necessary structural integrity to accommodate section lengths up to 26 feet.

- K. Splice Plates: Each section joint shall be tied together with two structural steel members per row, employing a minimum of four steel to steel through bolt connections at the nose beam and a minimum of eight steel to steel through bolt connections at the lower steel rear riser. Gauge of splice plates to match the gauge of the nose beam and rear riser. Splice plates employing steel to plywood deck board attachments will not be acceptable. Gauge of splice plates to match the gauge of the nose beam and rear riser. In order to minimize deflections and keep rows in alignment during operation, splice connections shall transfer both axial loads (tension/compression) and bending.
- L. Fasteners: All structural connections shall be made with S.A.E. grade 5 or better stress-rated bolts. The use of self-tapping bolts is not acceptable.
- M. Finish:
  - 1. Steel Understructure abraded, cleaned and finished with russet brown water base acrylic paint. Steel risers and nose beams finished with corrosion resistant silver gray matte finish with galvanized alloy plating.
  - 2. Zinc plated.

# 2.5 SEAT OPTIONS

- A. Sculpture Seat Modules:
  - 1. 18-inch wide one-piece individual seating modules shall be constructed of high-density polyethylene. Provide in 10" depth.
  - 2. Each module shall have two longitudinal and five transverse internal ribs to provide additional structural integrity and resistance to impact.
  - 3. Each module shall have a full <sup>1</sup>/<sub>2</sub>" interlock to the adjacent module both around the perimeter and along the internal ribs to eliminate pinching hazards and assures proper alignment.
  - 4. A steel-to-steel attachment of each module to a minimum 14 gauge galvanized steel nosebleed shall be provided for maximum rigidity. All such mounting hardware shall be concealed.
  - 5. End caps shall be provided at the ends of each bank of seating as well as at each aisle.
  - 6. Each module shall have a recessed area for optional seat numbering.
  - 7. Courtside graphic logo: Decorative graphic logo applied to integrally molded end cap recess area.
  - 8. Custom signature logo: Composed of contrasting seat modules to incorporate school letters; reference 21/A12.8 for nomenclature.
  - 9. Color: Provide colors of seat modules as indicated in Color and Materials Schedule and on Drawings to depict block letters as indicted when stands are in closed position. Total colors anticipated shall be no more than two colors.

# 2.6 INTEGRATED SCORER'S TABLE

- A. Integrated Scorer's Table:
  - 1. Size: 18-inch by 96" wide high pressure laminate top.

2. Bases: Manufacturer's "T" leg bases.

#### PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas where telescoping stands are to be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

A. Install telescoping stands to comply with referenced safety standard and manufacturer's written instructions.

### 3.3 ADJUSTING AND CLEANING

- A. On completion of installation, lubricate, test, and adjust each telescoping stand unit so that it operates according to manufacturer's written operating instructions.
- B. Clean installed telescoping stands on exposed and semi-exposed surfaces. Touch up shopapplied finishes or replace components as required to restore damaged or soiled areas.

### 3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain telescoping stands.

END OF SECTION 126600

# SECTION 210513 - COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION 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 the following:
  - 1. General requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
  - 2. Enclosed controllers rated 600 V and less:
    - a. Full-voltage manual.
    - b. Reduced voltage magnetic

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.

### 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

## 1.5 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.

## 1.6 SUBMITTALS

- A. Product Data: For each type of enclosed controller.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
- D. Field quality-control reports.
- E. Operation and maintenance data.

#### 1.7 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.
- B. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

#### 1.8 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. Comply with NFPA 70.

1.9 IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems".

# PART 2 - PRODUCTS

### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

- 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

# 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

# 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

# 2.6 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  - 2. Configuration: Non-reversing.
  - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
  - 4. Surface mounting.
  - 5. Green pilot light.

# 2.7 REDUCED-VOLTAGE MAGNETIC CONTROLLERS

- A. General Requirements for Reduced-Voltage Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A; closed-transition; adjustable time delay on transition.
- B. Combination Reduced-Voltage Magnetic Controller: Factory-assembled combination of reduced-voltage, electrically held magnetic controller and disconnecting means.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  - 2. Configuration:
    - a. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
  - 3. Contactor Coils: Pressure-encapsulated type.

- a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
- 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
- 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
  - a. CPT Spare Capacity: 200 VA.
- 6. Bimetallic Overload Relays:
  - a. Inverse-time-current characteristic.
  - b. Class 20 tripping characteristic.
  - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  - d. Ambient compensated.
  - e. Automatic resetting.
- 7. External overload reset push button.
- 8. Non-fusible Disconnecting Means:
  - a. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
  - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

# 2.8 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
  - 1. Dry and Clean Indoor Locations: Type 1.
  - 2. Outdoor Locations: Type 3R.
  - 3. Kitchen or Wash-Down Areas: Type 4X.
  - 4. Other Wet or Damp Indoor Locations: Type 4.
  - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

# 2.9 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  - 1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty.
    - a. Push Buttons: Unguarded types; maintained or momentary as indicated.
    - b. Pilot Lights: LED types; colors as indicated.

- B. Reversible N.C./N.O. auxiliary contact(s).
- C. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4, Type 4X, and Type 7 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- D. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 3R and Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- E. Spare control wiring terminal blocks, quantity as indicated; wired.

# PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Seismic Bracing: Comply with requirements specified in Division 26 Section "Seismic Controls for Electrical Systems."
- C. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- D. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- F. Comply with NECA 1.

#### 3.2 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 23 Section "Identification for HVAC Piping and Equipment."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved nameplate.
- B. Label each enclosure-mounted control and pilot device.

### 3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Division 26.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
- D. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

# 3.4 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers at 80 percent.

# 3.5 **PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

# 3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

# END OF SECTION 210513

# SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION 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. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.

#### 1.3 ACTION SUBMITTALS

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

#### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

# 2.2 STACK-SLEEVE FITTINGS

A. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

#### 2.3 SLEEVE-SEAL SYSTEMS

- A. 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: Stainless steel.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

### 2.4 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

### 2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

#### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. 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.
- C. 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.
- D. Install sleeves for pipes passing through interior 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."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

# 3.3 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.

# 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

# 3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 10: Galvanized-steel wall sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 10: Galvanized-steel-pipe 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) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 10: Galvanized-steel-pipe 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) 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 10: Sleeve-seal fittings.
    - b.

- 5. Interior Partitions:
  - a. Piping Smaller Than NPS 10: Galvanized-steel-pipe sleeves.

END OF SECTION 210517

# SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION 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.

### 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 and rough-brass 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.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

# ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

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 or split-casting brass type with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, castbrass or split-casting brass type with polished, chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting 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 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, chromeplated 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.

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# 3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 210518

SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION 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. Bronze butterfly valves with indicators.
  - 3. Check valves.
  - 4. Bronze OS&Y gate valves.
  - 5. Iron OS&Y gate valves.
  - 6. NRS gate valves.
  - 7. Trim and drain valves.

#### 1.3 DEFINITIONS

- A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- B. NRS: Nonrising stem.
- C. OS&Y: Outside screw and yoke.
- D. 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.
  - 3. Set valves open to minimize exposure of functional surfaces.
- 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:
  - 1. Main Level: HAMV Fire Main Equipment.
    - a. Level 1:, Gate Valve.
    - b. Level 1: HLOT Valves.
      - 1) Level 3: HLUG Ball Valves, System Control.
      - 2) Level 3: HLXS Butterfly Valves.
      - 3) Level 3: HMER Check Valves.
      - 4) Level 3: HMRZ Gate Valves.
  - 2. Main Level: VDGT Sprinkler System & Water Spray System Devices.
    - 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. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. NIBCO INC.
  - 2. Victaulic, Inc.
- B. Description:
  - 1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Body Design: Two piece.
  - 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.
  - 12. End Connections for Valves NPS 2-1/2: Grooved ends.

# 2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

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

- 1. Fivalco Inc.
- 2. Globe Fire Sprinkler Corporation.
- B. Description:
  - 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
  - 2. Minimum: Pressure rating: 175 psig.
  - 3. Body Material: Bronze.
  - 4. Seat Material: EPDM.
  - 5. Stem Material: Bronze or stainless steel.
  - 6. Disc: Bronze.
  - 7. Actuator: Worm gear or traveling nut.
  - 8. Supervisory Switch: Internal or external.
  - 9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
  - 10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

# 2.4 IRON BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Anvil International.
  - 2. Globe Fire Sprinkler Corporation.
  - 3. NIBCO INC.
  - 4. Tyco Fire & Building Products LP.
  - 5. Victaulic Company.
- B. Description:
  - 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
  - 4. Seat Material: EPDM.
  - 5. Stem: Stainless steel.
  - 6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
  - 7. Actuator: Worm gear or traveling nut.
  - 8. Supervisory Switch: Internal or external.
  - 9. Body Design: Lug or wafer.

# 2.5 CHECK VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Anvil International.
  - 2. Globe Fire Sprinkler Corporation.

- 3. NIBCO INC.
- 4. Tyco Fire & Building Products LP.
- 5. Viking Corporation.
- 6. Watts; a Watts Water Technologies company.
- B. Description:
  - 1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Type: Single swing check.
  - 4. Body Material: Cast iron, ductile iron, or bronze.
  - 5. Clapper: Bronze, ductile iron, or stainless steel.
  - 6. Clapper Seat: Brass, bronze, or stainless steel.
  - 7. Hinge Shaft: Bronze or stainless steel.
  - 8. Hinge Spring: Stainless steel.
  - 9. End Connections: Flanged, grooved, or threaded.

#### 2.6 BRONZE OS&Y GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Milwaukee Valve Company.
  - 2. NIBCO INC.
  - 3. Zurn Industries, LLC
- B. Description:
  - 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Yand NRS-type gate valves).
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Body and Bonnet Material: Bronze or brass.
  - 4. Wedge: One-piece bronze or brass.
  - 5. Wedge Seat: Bronze.
  - 6. Stem: Bronze or brass.
  - 7. Packing: Non-asbestos PTFE.
  - 8. Supervisory Switch: External.
  - 9. End Connections: Threaded.

#### 2.7 IRON OS&Y GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hammond Valve.
  - 2. Mueller Co.
  - 3. NIBCO INC.
  - 4. Victaulic Company.

### B. Description:

- 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Yand NRS-type gate valves).
- 2. Minimum Pressure Rating: 175 psig.
- 3. Body and Bonnet Material: Cast or ductile iron.
- 4. Wedge: Cast or ductile iron, or bronze.
- 5. Wedge Seat: Cast or ductile iron, or bronze.
- 6. Stem: Brass or bronze.
- 7. Packing: Non-asbestos PTFE.
- 8. Supervisory Switch: External.
- 9. End Connections: Flanged.

## 2.8 NRS GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mueller Co.
  - 2. NIBCO INC.
  - 3. Victaulic Company.
  - 4. Zurn Industries, LLC
- B. Description:
  - 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Yand NRS-type gate valves).
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Body and Bonnet Material: Cast or ductile iron.
  - 4. Wedge: Cast or ductile iron.
  - 5. Wedge Seat: Cast or ductile iron, or bronze.
  - 6. Stem: Brass or bronze.
  - 7. Packing: Non-asbestos PTFE.
  - 8. Supervisory Switch: External.
  - 9. End Connections: Flanged.

# 2.9 TRIM AND DRAIN VALVES

- A. Ball Valves:
  - 1. Anvil International.
  - 2. Kennedy Valve Company; a division of McWane, Inc.
  - 3. Milwaukee Valve Company.
  - 4. NIBCO INC.
  - 5. Potter Roemer LLC.
  - 6. Red-White Valve Corporation.
  - 7. Tyco Fire & Building Products LP.

- B. Description:
  - a. Pressure Rating: 175 psig.
  - 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.
- C. Angle 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. Fire Protection Products, Inc.
    - b. NIBCO INC.
  - 2. Description:
    - a. Pressure Rating: 175 psig.
    - 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.
- D. Globe Valves:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. NIBCO INC.
  - 2. Description:
    - a. Pressure Rating: 175 psig.
    - b. Body Material: Bronze with integral seat and screw-in bonnet.
    - c. Ends: Threaded.
    - d. Stem: Bronze.
    - e. Disc Holder and Nut: Bronze.
    - f. Disc Seat: Nitrile.
    - g. Packing: Asbestos free.
    - h. 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, firesuppression sprinkler systems.
- 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. 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.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. 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.

- H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.
- I. Install check valve in each water-supply connection.

END OF SECTION 210523

SECTION 210548 - VIBRATION AND SEISMIC CONTROLS 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. Elastomeric isolation pads.
  - 2. Elastomeric isolation mounts.
  - 3. Restrained elastomeric isolation mounts.
  - 4. Pipe-riser resilient supports.
  - 5. Resilient pipe guides.
  - 6. Elastomeric hangers.
  - 7. Snubbers.
  - 8. Restraint channel bracings.
  - 9. Seismic-restraint accessories.
  - 10. Mechanical anchor bolts.
  - 11. Adhesive anchor bolts.
- B. Related Requirements:
  - 1. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.
  - 2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

## 1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

## 1.4 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 and seismic-restraint component required.
  - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
  - b. Annotate to indicate application of each product submitted and compliance with requirements.
- 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
  - 1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
  - 3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
  - 4. Seismic-Restraint Details:
    - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
    - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.

- C. Welding certificates.
- D. Field quality-control reports.

# 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
  - 1. Reference Structural Contract Documents for Seismic critieria.
  - 2. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
    - a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

## 2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads: .
  - 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. Kinetics Noise Control, Inc.

- b. Mason Industries, Inc.
- c. Vibration Eliminator Co., Inc.
- 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
- 3. Size: Factory or field cut to match requirements of supported equipment.
- 4. Pad Material: Oil and water resistant with elastomeric properties.
- 5. Surface Pattern: Ribbed pattern.
- 6. Infused nonwoven cotton or synthetic fibers.
- 7. Load-bearing metal plates adhered to pads.

#### 2.3 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts: .
  - 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. Kinetics Noise Control, Inc.
    - b. Mason Industries, Inc.
    - c. Vibration Isolation.
  - 2. Mounting Plates:
    - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
    - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
  - 3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

- A. Restrained Elastomeric Isolation Mounts: .
  - 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. Kinetics Noise Control, Inc.
    - b. Mason Industries, Inc.
    - c. Vibration Isolation.
  - 2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

- a. Housing: Cast-ductile iron or welded steel.
- b. Elastomeric Material: Molded, oil-resistant rubber, neoprene or other elastomeric material.

# 2.5 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.
  - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  - 2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

#### 2.6 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.

## 2.7 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .
  - 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. Kinetics Noise Control, Inc.
    - b. Mason Industries, Inc.
    - c. Vibration Eliminator Co., Inc.
  - 2. 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.
  - 3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

#### 2.8 SNUBBERS

- 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. Kinetics Noise Control, Inc.
  - 2. Mason Industries, Inc.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
  - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
  - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
  - 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

# 2.9 RESTRAINT CHANNEL BRACINGS

- 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. B-line, an Eaton business.
  - 2. Hilti, Inc.
  - 3. Mason Industries, Inc.
- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

## 2.10 SEISMIC-RESTRAINT ACCESSORIES

- 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. B-line, an Eaton business.
  - 2. Kinetics Noise Control, Inc.
  - 3. Mason Industries, Inc.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

#### 2.11 MECHANICAL ANCHOR BOLTS

- 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. B-line, an Eaton business.
  - 2. Hilti, Inc.
  - 3. Kinetics Noise Control, Inc.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

#### 2.12 ADHESIVE ANCHOR BOLTS

- A. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

#### 3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of equipment supports and roof penetrations.
- D. Equipment Restraints:
  - 1. Install seismic snubbers on fire-suppression equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
  - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Piping Restraints:
  - 1. Comply with requirements in MSS SP-127.
  - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  - 3. Brace a change of direction longer than 12 feet.
- F. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

- I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- J. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

# 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for piping flexible connections.

# 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

- 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
- 5. Test to 90 percent of rated proof load of device.
- 6. Measure isolator restraint clearance.
- 7. Measure isolator deflection.
- 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

END OF SECTION 210548

#### 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. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Stencils.
  - 5. Valve tags.
  - 6. Warning tags.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- D. Valve Schedules: Valve numbering scheme.

## PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 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. Carlton Industries, LP.
    - b. Craftmark Pipe Markers.

- c. Marking Services, Inc.
- 2. Material and Thickness: Brass, 0.032 inch or thick, with predrilled holes for attachment hardware.
- 3. Letter Color: Red.
- 4. Background Color: White.
- 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 7. Fasteners: Stainless-steel rivets or self-tapping screws.
- 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
  - 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. Champion America.
    - b. Craftmark Pipe Markers.
    - c. Marking Services, Inc.
  - 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
  - 3. Letter Color: Red.
  - 4. Background Color: White .
  - 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 7. 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.
  - 8. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 9. 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.
- D. 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 WARNING SIGNS AND LABELS

- 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. Champion America.
  - 2. Craftmark Pipe Markers.
  - 3. National Marker Company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- C. Letter Color: White.
- D. Background Color: Red.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. 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.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

- 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. Champion America.
  - 2. Craftmark Pipe Markers.
  - 3. Marking Sevices Inc.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- E. 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: Size letters according to ASME A13.1 for piping.
- F. Pipe-Label Colors:
  - 1. Background Color: Safety Red.
  - 2. Letter Color: White.

# 2.4 STENCILS

- A. Stencils for Piping:
  - 1. Lettering Size: Size letters according to ASME A13.1 for piping.
  - 2. Stencil Material: Aluminum.
  - 3. Stencil Paint: Safety Red, exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
  - 4. Identification Paint: White, exterior, alkyd enamel. Paint may be in pressurized spray-can form.

## 2.5 VALVE TAGS

- 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. Champion America.
  - 2. Craftmark Pipe Markers.
  - 3. Marking Sevices Inc.
- B. 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.
- C. 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.

#### 2.6 WARNING TAGS

- 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. Champion America.
  - 2. Craftmark Pipe Markers.
  - 3. Marking Sevices Inc.
- B. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Safety Yellow background with black lettering.

## 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. Piping: Painting of piping is specified in Section 099123 "Interior Painting."

- B. Stenciled Pipe-Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- C. 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. At access doors, manholes, and similar access points that permit a view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. 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:
    - a. Fire-Suppression Standpipe: 2 inches, round.
    - b. Wet-Pipe Sprinkler System: 2 inches, round.

#### 3.6 WARNING-TAG INSTALLATION

A. 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.
  - 3. Specialty valves.
  - 4. Sprinklers.
  - 5. Alarm devices.
  - 6. Manual control stations.
  - 7. Control panels.
  - 8. Pressure gages.

#### 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. Sustainable Design Submittals:
  - 1. Product Data: For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For wet-pipe sprinkler systems.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include diagrams for power, signal, and control wiring.

D. 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. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Domestic water piping.
  - 2. HVAC hydronic piping.
  - 3. Items penetrating finished ceiling include the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
- B. Qualification Data: For qualified Installer and professional engineer.
- C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Fire-hydrant flow test report.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- G. 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

## 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.
- B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

## 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 Owner no fewer than two days in advance of proposed interruption of sprinkler service.
  - 2. Do not proceed with interruption of sprinkler service without Owner's written permission.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13.
- 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. 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) Automobile Parking Areas: Ordinary Hazard, Group 1.
      - 2) Building Service Areas: Ordinary Hazard, Group 1.
      - 3) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
      - 4) General Storage Areas: Ordinary Hazard, Group 1.

- 5) Laundries: Ordinary Hazard, Group 1.
- 6) Libraries except Stack Areas: Light Hazard.
- 7) Library Stack Areas: Ordinary Hazard, Group 2.
- 8) Machine Shops: Ordinary Hazard, Group 2.
- 9) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
- 10) Office and Public Areas: Light Hazard.
- 11) Repair Garages: Ordinary Hazard, Group 2.
- 2. 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.
  - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
  - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
  - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- 3. Maximum Protection Area per Sprinkler: According to UL listing.
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

#### 2.2 STEEL PIPE AND FITTINGS

- A. Thinwall Galvanized- and Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- B. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Galvanized- and Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.
- D. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. 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.
    - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
    - 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.
- G. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

- 1. 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.
- H. Grooved-Joint, Steel-Pipe Appurtenances:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International.
    - b. Tyco Fire & Building Products LP.
  - 2. Pressure Rating: 175-psig minimum.
  - 3. Painted 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.
  - 4. 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:
  - 1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.
  - 2. High-Pressure Piping Specialty Valves: 250-psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. Alarm Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Globe Fire Sprinkler Corporation.
    - b. Reliable Automatic Sprinkler Co., Inc. (The).
    - c. Tyco Fire & Building Products LP.
    - d. Victaulic Company.
  - 2. Standard: UL 193.
  - 3. Design: For horizontal or vertical installation.
  - 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.

- 5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
- 6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
- 7. 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.
- G. Automatic (Ball Drip) Drain Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Reliable Automatic Sprinkler Co., Inc. (The).
  - 2. Standard: UL 1726.
  - 3. Pressure Rating: 175-psig minimum.
  - 4. Type: Automatic draining, ball check.
  - 5. Size: NPS 3/4.
  - 6. End Connections: Threaded.

#### 2.4 SPRINKLER PIPING SPECIALTIES

- A. 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. (The).
    - c. Tyco Fire & Building Products LP.
  - 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
  - 3. Pressure Rating: 175-psig minimum.
  - 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.
- B. Sprinkler Inspector's Test Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AGF Manufacturing Inc.
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
  - 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

- 3. Pressure Rating: 175-psig minimum.
- 4. Body Material: Cast- or ductile-iron housing with sight glass.
- 5. Size: Same as connected piping.
- 6. Inlet and Outlet: Threaded.
- C. 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.
  - 2. Standard: UL 1474.
  - 3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
  - 4. Pressure Rating: 175-psig minimum.
  - 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:
  - 1. Globe Fire Sprinkler Corporation.
  - 2. Reliable Automatic Sprinkler Co., Inc. (The).
  - 3. Tyco Fire & Building Products LP.
  - 4. Victaulic Company.
- 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:
  - 1. Early-Suppression, Fast-Response Applications: UL 1767.
  - 2. Nonresidential Applications: UL 199.
  - 3. 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. (The).
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
  - 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-Motor-Operated Alarm:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Globe Fire Sprinkler Corporation.
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
  - 2. Standard: UL 753.
  - 3. Type: Mechanically operated, with Pelton wheel.
  - 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
  - 5. Size: 8-1/2-inches diameter.
  - 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
  - 7. Inlet: NPS 3/4.
  - 8. Outlet: NPS 1 drain connection.
- C. Water-Flow Indicators:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Potter Electric Signal Company, LLC.
    - b. System Sensor.
    - c. Viking Corporation.
  - 2. Standard: UL 346.

- 3. Water-Flow Detector: Electrically supervised.
- 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.
- 6. Pressure Rating: 250 psig.
- 7. Design Installation: Horizontal or vertical.
- D. Pressure Switches:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Potter Electric Signal Company, LLC.
    - b. Tyco Fire & Building Products LP.
    - c. United Electric Controls Co.
  - 2. Standard: UL 346.
  - 3. Type: Electrically supervised water-flow switch with retard feature.
  - 4. Components: Single-pole, double-throw switch with normally closed contacts.
  - 5. Design Operation: Rising pressure signals water flow.
- E. Valve Supervisory Switches:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
    - b. Kennedy Valve Company; a division of McWane, Inc.
    - c. Potter Electric Signal Company, LLC.
  - 2. Standard: UL 346.
  - 3. Type: Electrically supervised.
  - 4. Components: Single-pole, double-throw switch with normally closed contacts.
  - 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.
  - 7. Rectifier.

# 2.7 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AGF Manufacturing Inc.
  - 2. AMETEK, Inc.

- 3. Ashcroft Inc.
- 4. Brecco 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-pump 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 SERVICE-ENTRANCE PIPING

- A. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-service piping.
- B. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

## 3.3 WATER-SUPPLY CONNECTIONS

- A. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.
- B. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

## 3.4 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. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. 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.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- M. 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.
- N. Fill sprinkler system piping with water.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

### 3.5 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. 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.
- I. 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.

## 3.6 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.

# 3.7 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

## 3.8 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."

## 3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 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.
  - 6. Coordinate with fire-pump tests. Operate as required.
  - 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.10 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.

#### 3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

## 3.12 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. Thin-wall, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  - 2. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be one of the following:
  - 1. Thinwall, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  - 2. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 3. Thinwall black-steel pipe with plain ends; welding fittings; and welded joints.

### 3.13 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.
  - 3. Wall Mounting: Sidewall sprinklers.
  - 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers.
  - 5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where required. Attic sprinklers. Combustible concealed space sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
  - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

2. 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 FIRE SUPPRESSION 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 the following:
  - 1. General requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
  - 2. Enclosed controllers rated 600 V and less:
    - a. Full-voltage manual.
    - b. Reduced voltage magnetic

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.

### 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

### 1.5 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.

### 1.6 SUBMITTALS

- A. Product Data: For each type of enclosed controller.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
- D. Field quality-control reports.
- E. Operation and maintenance data.

#### 1.7 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.
- B. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

### 1.8 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. Comply with NFPA 70.

1.9 IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems".

## PART 2 - PRODUCTS

### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

- 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

## 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

## 2.6 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  - 2. Configuration: Non-reversing.
  - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
  - 4. Surface mounting.
  - 5. Green pilot light.

## 2.7 REDUCED-VOLTAGE MAGNETIC CONTROLLERS

- A. General Requirements for Reduced-Voltage Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A; closed-transition; adjustable time delay on transition.
- B. Combination Reduced-Voltage Magnetic Controller: Factory-assembled combination of reduced-voltage, electrically held magnetic controller and disconnecting means.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  - 2. Configuration:
    - a. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
  - 3. Contactor Coils: Pressure-encapsulated type.

- a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
- 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
- 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
  - a. CPT Spare Capacity: 200 VA.
- 6. Bimetallic Overload Relays:
  - a. Inverse-time-current characteristic.
  - b. Class 20 tripping characteristic.
  - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  - d. Ambient compensated.
  - e. Automatic resetting.
- 7. External overload reset push button.
- 8. Non-fusible Disconnecting Means:
  - a. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
  - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

## 2.8 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
  - 1. Dry and Clean Indoor Locations: Type 1.
  - 2. Outdoor Locations: Type 3R.
  - 3. Kitchen or Wash-Down Areas: Type 4X.
  - 4. Other Wet or Damp Indoor Locations: Type 4.
  - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

## 2.9 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  - 1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty.
    - a. Push Buttons: Unguarded types; maintained or momentary as indicated.
    - b. Pilot Lights: LED types; colors as indicated.

- B. Reversible N.C./N.O. auxiliary contact(s).
- C. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4, Type 4X, and Type 7 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- D. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 3R and Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- E. Spare control wiring terminal blocks, quantity as indicated; wired.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Seismic Bracing: Comply with requirements specified in Division 26 Section "Seismic Controls for Electrical Systems."
- C. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- D. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- F. Comply with NECA 1.

#### 3.2 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 23 Section " Identification for HVAC Piping and Equipment."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved nameplate.
- B. Label each enclosure-mounted control and pilot device.

### 3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Division 26.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
- D. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

## 3.4 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers at 80 percent.

# 3.5 **PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

## 3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

## END OF SECTION 220513

# SECTION 220516 - EXPANSION FITTINGS AND LOOPS 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. Flexible-hose packless expansion joints.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Welding certificates.
- D. Product Certificates: For each type of expansion joint, from manufacturer.
- E. Maintenance Data: For expansion joints to include in maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
  - 2. ASME Boiler and Pressure Vessel Code: Section IX.
  - 3. Washington Association of Building Officials

### PART 2 - PRODUCTS

#### 2.1 PACKLESS EXPANSION JOINTS

- A. Flexible-Hose Packless Expansion Joints:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flexicraft Industries.
    - b. Flex Pression Ltd.
    - c. Metraflex, Inc.
    - d. Unisource Manufacturing, Inc.
  - 2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
  - 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
  - 4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
    - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
  - 5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
  - 6. Expansion Joints for Steel Piping NPS 2 and Smaller: Stainless-steel fittings with threaded end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
  - 7. Expansion Joints for Cast Iron and Steel Piping NPS 2-1/2 to NPS 6: Stainless-steel fittings with flanged end connections.

- a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
- b. Clean out tee where used in waste system.

# PART 3 - EXECUTION

### 3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

### END OF SECTION 220516

# SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION 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. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.

#### 1.3 ACTION SUBMITTALS

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

#### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

## 2.2 STACK-SLEEVE FITTINGS

A. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

### 2.3 SLEEVE-SEAL SYSTEMS

- A. 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: Stainless steel.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

### 2.4 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

### 2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

#### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. 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.
- C. 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.
- D. Install sleeves for pipes passing through interior 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."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

## 3.3 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.

## 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

## 3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 10: Galvanized-steel wall sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 10: Galvanized-steel-pipe 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) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 10: Galvanized-steel-pipe 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) 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 10: Sleeve-seal fittings.
    - b.

- 5. Interior Partitions:
  - a. Piping Smaller Than NPS 10: Galvanized-steel-pipe sleeves.

END OF SECTION 220517

## SECTION 220518 - ESCUTCHEONS FOR FIRE-SUPPRESSION 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.

### 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 and rough-brass 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.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

#### ESCUTCHEONS FOR PLUMBING PIPING

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 or split-casting brass type with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, castbrass or split-casting brass type with polished, chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting 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 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, chromeplated 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.

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# 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.
  - 7. Sight flow indicators.
- B. Related Requirements:
  - 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 221119 "Domestic Water Piping Specialties" for water meters.
  - 3. Section 221513 "General-Service Compressed-Air Piping" for compressed air gages.

# 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

### 1.5 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. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Trerice, H. O. Co</u>.
    - b. <u>Weiss Instruments, Inc</u>.
    - c. <u>WIKA Instrument Corporation</u>.
  - 2. Case: Metal; 9-inch nominal size unless otherwise indicated.
  - 3. Scale(s): Deg F and deg C.
  - 4. Case Form: Adjustable angle.
  - 5. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
  - 6. Stem: Aluminum and of length to suit installation.
    - a. Design for Thermowell Installation: Bare stem.
  - 7. Display: Digital.
  - 8. Accuracy: Plus or minus 2 deg F.
- B. Remote-Mounted, Light-Activated Thermometers:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Miljoco Corporation</u>.
    - b. <u>Weiss Instruments, Inc</u>.
  - 2. Case: Plastic, for wall mounting.
  - 3. Scale(s): Deg F and deg C.
  - 4. Sensor: Bulb and thermister wire.
    - a. Design for Thermowell Installation: Bare stem.
  - 5. Display: Digital.
  - 6. Accuracy: Plus or minus 2 deg F.

# 2.2 THERMOWELLS

- A. Thermowells:
  - 1. Standard: ASME B40.200.
  - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.

## METERS AND GAGES FOR PLUMBING PIPING

- 3. Material for Use with Copper Tubing: CNR or CUNI.
- 4. Material for Use with Steel Piping: CRES.
- 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. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Ametek U.S. Gauge</u>.
    - b. <u>Ashcroft Inc</u>.
    - c. <u>Miljoco Corporation</u>.
    - d. <u>Trerice, H. O. Co</u>.
    - e. <u>Watts; a Watts Water Technologies company</u>.
    - f. <u>Weiss Instruments, Inc</u>.
  - 2. Standard: ASME B40.100.
  - 3. Case: Liquid-filled 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 or NPS 1/2, 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.
  - 8. Pointer: Dark-colored metal.
  - 9. Window: Glass or plastic.
  - 10. Ring: Brass.
  - 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.
- B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Ametek U.S. Gauge</u>.
    - b. <u>Ashcroft Inc</u>.
    - c. <u>Miljoco Corporation</u>.
    - d. <u>Trerice, H. O. Co</u>.

- e. <u>Watts; a Watts Water Technologies company</u>.
- f. <u>Weiss Instruments, Inc</u>.
- 2. Standard: ASME B40.100.
- 3. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter with front flange and holes for panel mounting.
- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, 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.
- 8. Pointer: Dark-colored metal.
- 9. Window: Glass or plastic.
- 10. Ring: Metal.
- 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

## 2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, 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 or NPS 1/2, ASME B1.20.1 pipe threads.

## 2.5 TEST PLUGS

- A. Description: Test-station fitting made for insertion into piping tee fitting.
- B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- C. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- E. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

## 2.6 TEST-PLUG KITS

- A. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- B. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- C. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.

D. Carrying Case: Metal or plastic, with formed instrument padding.

## 2.7 SIGHT FLOW INDICATORS

- A. Description: Piping inline-installation device for visual verification of flow.
- B. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- C. Minimum Pressure Rating: 150 psig.
- D. Minimum Temperature Rating: 200 deg F.
- E. End Connections for NPS 2 and Smaller: Threaded.
- F. End Connections for NPS 2-1/2 and Larger: Flanged.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid 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 remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
  - 1. Inlet and outlet of each water heater.

## METERS AND GAGES FOR PLUMBING PIPING

- 2. Inlet and outlet of each domestic hot-water storage tank.
- L. Install pressure gages in the following locations:
  - 1. Building water service entrance into building.
  - 2. Inlet and outlet of each pressure-reducing valve.
  - 3. Suction and discharge of each domestic water pump.
- 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 Remote-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: 30 to 240 deg F.

#### 3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be the following:
  - 1. Liquid-filled, 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. Liquid-filled, 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. Liquid-filled, direct-mounted, metal case.

#### METERS AND GAGES FOR PLUMBING PIPING

- 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 160 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. Brass ball valves.
  - 2. Bronze ball valves.

### 1.3 DEFINITIONS

A. CWP: Cold working pressure.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 Annex G and NSF 372.

### 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.
  - 3. Set ball valves open to minimize exposure of functional surfaces.
- 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.
  - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 5. ASME B16.18 for solder-joint connections.
  - 6. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- 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. Gear Actuator: For quarter-turn valves [NPS 4] <Insert size> and larger.
  - 2. Handlever: For quarter-turn valves smaller than [NPS 4] <Insert size>.
- 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 BRASS BALL VALVES

- A. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. Jomar Valve.
    - b. <u>KITZ Corporation</u>.
    - c. <u>Marwin Valve; Richards Industries</u>.

- 2. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Two piece.
  - d. Body Material: Forged brass.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel, vented.
  - i. Port: Full.

## 2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Crane; Crane Energy Flow Solutions</u>.
    - b. <u>Hammond Valve</u>.
    - c. <u>Milwaukee Valve Company</u>.
    - d. <u>NIBCO INC</u>.
  - 2. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Bronze.
    - e. Ends: Threaded or soldered.
    - f. Seats: PTFE.
    - g. Stem: Stainless steel.
    - h. Ball: Stainless steel, vented.
    - 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 220553 "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 valveend option is indicated in valve schedules below.

#### 3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Brass ball valves, two-piece with full port and stainless-steel trim.
  - 3. Bronze ball valves, two-piece with full port and stainless-steel trim.

# END OF SECTION 220523.12

## SECTION 220523.13 - BUTTERFLY 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. Iron, single-flange butterfly valves.
  - 2. Chainwheels.

### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 Annex G and NSF 372.

## 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 butterfly valves closed or slightly open.
- 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 B16.1 for flanges on iron valves.
  - 2. ASME B16.5 for flanges on steel valves.
  - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 4. ASME B31.9 for building service piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- 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. Gear Actuator: For valves NPS 8 and larger.
  - 2. Handlever: For valves NPS 6 and smaller.
  - 3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain for mounting height, according to "Valve Installation" Article.
- H. Valves in Insulated Piping: With 2-inch stem extensions.

## 2.2 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Hammond Valve</u>.
    - b. <u>Milwaukee Valve Company</u>.
    - c. <u>NIBCO INC</u>.
    - d. <u>Red-White Valve Corporation</u>.
  - 2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating, NPS 12 and Smaller: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Stainless steel.

## 2.3 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to handwheels.
  - 1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
  - 2. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine mating flange faces for damage. 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.
- D. Do not attempt to repair defective valves; replace with new valves.

## 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- 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 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, stainless-steel disc.

END OF SECTION 220523.13

## SECTION 220523.14 - CHECK 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 swing check valves.
  - 2. Iron, center-guided check valves.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 Annex G and NSF 372.

## 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. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- 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. Bronze Swing Check Valves with Bronze Disc, Class 150, :
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Crane; Crane Energy Flow Solutions</u>.
    - b. <u>Milwaukee Valve Company</u>.
    - c. <u>NIBCO INC</u>.
    - d. <u>Red-White Valve Corporation</u>.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 3.
    - b. CWP Rating: 300 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.

- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: Bronze.

## 2.3 IRON, CENTER-GUIDED, SPRING-LOADED CHECK VALVES

- A. Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat, Class 150, :
  - 1. <u>Manufacturers:</u> 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. <u>APCO Willamette Valve and Primer Corporation</u>.
    - b. <u>Crispin Valve</u>.
  - 2. Description:
    - a. Standard: MSS SP-125.
    - b. CWP Rating: 300 psig.
    - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
    - d. Style: Compact wafer, spring loaded.
    - e. 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.

#### CHECK VALVES FOR PLUMBING PIPING

- 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.

## 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 for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat check valves.
- 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 Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
  - 3. For Copper Tubing, NPS 5 and Larger: Flanged.

## 3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Bronze swing check valves with bronze disc, Class 150, with soldered or threaded end connections.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Iron, center-guided check valves with compact wafer, Class 150.

#### END OF SECTION 220523.14

## SECTION 220523.15 - GATE 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. Iron gate valves.
  - 2. Chainwheels.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. NRS: Nonrising stem.
- C. OS&Y: Outside screw and yoke.
- D. RS: Rising stem.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 Annex G and NSF 372.

# 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 gate valves closed to prevent rattling.
- 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. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- 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. RS Valves in Insulated Piping: With 2-inch stem extensions.
- H. Valve Bypass and Drain Connections: MSS SP-45.

#### 2.2 IRON GATE VALVES

- A. Iron Gate Valves, NRS, Class 250:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. <u>NIBCO INC</u>.
  - 2. Description:
    - a. Standard: MSS SP-70, Type I.
    - b. CWP Rating: 500 psig.
    - c. Body Material: Gray iron with bolted bonnet.
    - d. Ends: Flanged.

- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

## 2.3 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to hand wheels.
  - 1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
  - 2. Chain: Hot-dip galvanized steel, of size required to fit sprocket rim.

#### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

## 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. Use gate valves for shutoff service only.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

## 3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger: Iron gate valves, NRS, Class 250 with flanged ends.

### END OF SECTION 220523.15

## 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 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.
  - 2. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

#### 1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

- 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- 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. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Pipe stands.
  - 4. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers.
  - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

# 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.
- 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

## 2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Allied Tube & Conduit; a part of Atkore International</u>.
    - b. <u>B-line, an Eaton business</u>.
    - c. <u>Flex-Strut Inc</u>.
    - d. Thomas & Betts Corporation; A Member of the ABB Group.
    - e. <u>Unistrut; Part of Atkore International</u>.
  - 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
  - 3. Standard: MFMA-4.
  - 4. Channels: Continuous slotted steel channel with inturned lips.
  - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  - 7. Metallic Coating: Hot-dipped galvanized.

## 2.4 THERMAL-HANGER SHIELD INSERTS

- A. <u>Manufacturers:</u> 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. <u>National Pipe Hanger Corporation</u>.
  - 2. <u>Pipe Shields Inc</u>.
  - 3. <u>Rilco Manufacturing Co., Inc.</u>

- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-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 minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, [**zinc-coated**] [**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. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
  - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 2. Base: Plastic.
  - 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 plastic or stainlesssteel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
  - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

- 2. Bases: One or more; plastic.
- 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.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structuralsteel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## 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 carbonsteel 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.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 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. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 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.
- F. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. 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.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. 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.

- O. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weightdistribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weightdistribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

## 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

## 3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 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.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

## 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow offcenter closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steelpipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  - 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  - 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

- 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
- 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  - 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. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  - 5. 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. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  - 6. C-Clamps (MSS Type 23): For structural shapes.
  - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel Ibeams for heavy loads.
  - 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel Ibeams for heavy loads, with link extensions.
  - 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

- 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
  - a. Light (MSS Type 31): 750 lb.
  - b. Medium (MSS Type 32): 1500 lb.
  - c. Heavy (MSS Type 33): 3000 lb.
- 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Elastomeric isolation pads.
  - 2. Elastomeric isolation mounts.
  - 3. Restrained elastomeric isolation mounts.
  - 4. Open-spring isolators.
  - 5. Housed-spring isolators.
  - 6. Restrained-spring isolators.
  - 7. Housed-restrained-spring isolators.
  - 8. Pipe-riser resilient supports.
  - 9. Resilient pipe guides.
  - 10. Elastomeric hangers.
  - 11. Spring hangers.
  - 12. Snubbers.
  - 13. Restraint channel bracings.
  - 14. Restraint cables.
  - 15. Seismic-restraint accessories.
  - 16. Mechanical anchor bolts.
  - 17. Adhesive anchor bolts.
- B. Related Requirements:
  - 1. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
  - 2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.
- 1.3 DEFINITIONS
  - A. IBC: International Building Code.
  - B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

#### 1.4 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 and seismic-restraint component required.
    - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    - b. Annotate to indicate application of each product submitted and compliance with requirements.
  - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
  - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
  - 1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
  - 3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
  - 4. Seismic-Restraint Details:
    - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

# PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading: Reference Structural Contract Documents.
  - 1. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

# 2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>.
  - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 3. Size: Factory or field cut to match requirements of supported equipment.
  - 4. Pad Material: Oil and water resistant with elastomeric properties.
  - 5. Surface Pattern: Ribbed pattern.
  - 6. Infused nonwoven cotton or synthetic fibers.
  - 7. Load-bearing metal plates adhered to pads.

# 2.3 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>.
  - 2. Mounting Plates:
    - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
    - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
  - 3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

- A. Restrained Elastomeric Isolation Mounts:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>.
  - 2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
    - a. Housing: Cast-ductile iron or welded steel.
    - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

# 2.5 OPEN-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>
  - 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. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
  - 7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

# 2.6 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:

- a. <u>California Dynamics Corporation</u>.
- b. <u>Kinetics Noise Control, Inc</u>.
- c. <u>Mason Industries, Inc</u>.
- d. <u>Vibration Isolation</u>
- 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. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
  - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Top housing with threaded mounting holes and internal leveling device.

# 2.7 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>
  - 2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
    - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Top plate with threaded mounting holes.
    - c. Internal leveling bolt that acts as blocking during installation.
  - 3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
  - 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: .

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
  - a. <u>California Dynamics Corporation</u>.
  - b. <u>Kinetics Noise Control, Inc</u>.
  - c. <u>Mason Industries, Inc</u>.
  - d. <u>Vibration Isolation</u>
- 2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
  - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
- 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

# 2.9 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
  - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  - 2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

# 2.10 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
  - 2. 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.

3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

# 2.11 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>.
  - 2. 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.
  - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  - 8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
  - 9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.12 SNUBBERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
  - 1. <u>Kinetics Noise Control, Inc</u>.
  - 2. <u>Mason Industries, Inc</u>.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
  - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
  - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

#### 2.13 RESTRAINT CHANNEL BRACINGS

A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

#### 2.14 RESTRAINT CABLES

A. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

## 2.15 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## 2.16 MECHANICAL ANCHOR BOLTS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
  - 1. <u>B-line, an Eaton business</u>.
  - 2. <u>Hilti, Inc</u>.
  - 3. <u>Kinetics Noise Control, Inc</u>.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

#### 3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
  - 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
  - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

- E. Piping Restraints:
  - 1. Comply with requirements in MSS SP-127.
  - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  - 3. Brace a change of direction longer than 12 feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- K. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

## 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 221116 "Domestic Water Piping" for piping flexible connections.

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# 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  - 5. Test to 90 percent of rated proof load of device.
  - 6. Measure isolator restraint clearance.
  - 7. Measure isolator deflection.
  - 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

# 3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 220548

## 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. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Stencils.
  - 5. Valve tags.
  - 6. Warning tags.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

#### PART 2 - PRODUCTS

- 2.1 EQUIPMENT LABELS
  - A. Metal Labels for Equipment:
    - 1. Material and Thickness: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
    - 2. Letter Color: Black.
    - 3. Background Color: White.

- 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-quarters the size of principal lettering.
- 6. Fasteners: Stainless-steel rivets or self-tapping screws.
- 7. 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 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. 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.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full 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; 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: Size letters according to ASME A13.1 for piping.

## 2.4 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.
- 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.

## 2.5 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Safety yellow background with black lettering.
# PART 3 - EXECUTION

#### 3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

#### 3.2 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- 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.
- b. Letter Colors: White.
- 2. Sanitary Waste and Storm Drainage Piping:
  - a. Background Color: Safety purple.
  - b. Letter Color: White.

#### 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 similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Cold Water: 2 inches, round.
    - b. Hot Water: 2 inches, round.
  - 2. Valve-Tag Colors:
    - a. Cold Water: Safety green.
    - b. Hot Water: Safety green.
  - 3. Letter Colors:
    - a. Cold Water: White.
    - b. Hot Water: White.

### 3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

# SECTION 220716 - PLUMBING EQUIPMENT INSULATION

# PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes insulating the following plumbing equipment:1. Domestic water, hot-water pumps.
- B. Related Sections:
  - 1. Section 220719 "Plumbing Piping 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).
- B. Sustainable Design Submittals:
  - 1. <u>Product Data</u>: For adhesives, mastics, and sealants, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail removable insulation at equipment connections and access panels.
  - 4. Detail application of field-applied jackets.
  - 5. Detail application at linkages of control devices.
  - 6. Detail field application for each equipment type.

# 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation

materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

# 1.5 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.

### 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 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.
- C. Coordinate installation and testing of heat tracing.

#### 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 "Domestic Water Boiler Breeching Insulation Schedule" and "Equipment 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. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>CertainTeed Corporation</u>.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. <u>Knauf Insulation</u>.

### 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. <u>Adhesive</u>: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.
  - 2. <u>Adhesive shall comply with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.

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### 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. <u>Mastics shall comply with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 4. Color: White.

# 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.
  - 4. Color: White.
  - 5. <u>Sealant shall comply with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

#### 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.

# 2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 11.5 mils.

# PLUMBING EQUIPMENT INSULATION

- 3. Adhesion: 90 ounces force/inch in width.
- 4. Elongation: 2 percent.
- 5. Tensile Strength: 40 lbf/inch in width.
- 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

# 2.8 SECUREMENTS

- A. Bands:
  - 1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

# 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 and equipment 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. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- 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 equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item 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.
  - 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches] [4 inches] 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.
- 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.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

# 3.4 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

# 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing fieldapplied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

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# 3.6 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment that is not factory insulated.
- C. Domestic water pump insulation shall be the following:
  1. Mineral-Fiber Board: 1 inch thick and 2-lb/cu. ft. nominal density.

END OF SECTION 220716

# 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. Sanitary waste piping.
  - 5. Roof drains and rainwater leaders, including over flow drains and leaders.
  - 6. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
  - 1. Section 220716 "Plumbing Equipment 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).
- B. Sustainable Design Submittals:
  - 1. <u>Product Data</u>: For adhesives, mastics, and sealants, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.

7. Detail application at linkages of control devices.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.5 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. Supply and Drain Protective Shielding Guards: ICC A117.1.

#### 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 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.

#### 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 "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. 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 I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>CertainTeed Corporation</u>.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. <u>Knauf Insulation</u>.
- G. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:

- a. Johns Manville; a Berkshire Hathaway company.
- b. <u>Knauf Insulation</u>.
- c. <u>Manson Insulation Inc</u>.
- 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-SSL. Factoryapplied 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. <u>Manufacturers:</u> 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. <u>Childers Brand; H. B. Fuller Construction Products</u>.
    - b. <u>Eagle Bridges Marathon Industries</u>.
    - c. Foster Brand; H. B. Fuller Construction Products.
  - 2. <u>Adhesive</u>: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. <u>Manufacturers:</u> 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. <u>Childers Brand; H. B. Fuller Construction Products</u>.
    - b. <u>Eagle Bridges Marathon Industries</u>.
    - c. Foster Brand; H. B. Fuller Construction Products.
  - 2. <u>Adhesives shall have a VOC</u> content of 80 g/L or less.
  - 3. <u>Adhesives and sealants shall comply</u> with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. PVC Jacket Adhesive: Compatible with PVC jacket.

- 1. <u>Adhesive</u>: As recommended by Adhesive PVC Jacket manufacturer and with a VOC content of 50 g/L or less.
- 2. <u>Adhesives and sealants shall comply</u> with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

# 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. <u>Mastics</u>: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
  - 2. <u>Mastics shall comply with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: 60 percent by volume and 66 percent by weight.
  - 4. Color: White.

# 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
  - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fireresistant lagging cloths over pipe insulation.
  - 3. Service Temperature Range: 0 to plus 180 deg F.
  - 4. Color: White.

#### 2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. <u>Manufacturers:</u> 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. <u>Childers Brand; H. B. Fuller Construction Products</u>.
    - b. Eagle Bridges Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 5. Color: Aluminum.
  - 6. <u>Sealant shall have a VOC</u> content of 420 g/L or less.
  - 7. <u>Sealant shall comply with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. 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.
  - 4. Color: White.
  - 5. <u>Sealant shall have a VOC</u> content of 420 g/L or less.
  - 6. <u>Sealant shall comply with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

### 2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

### 2.8 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. <u>Manufacturers:</u> 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. Johns Manville; a Berkshire Hathaway company.
    - b. <u>P.I.C. Plastics, Inc</u>.
    - c. <u>Proto Corporation</u>.
  - 2. Adhesive: As recommended by jacket material manufacturer.
  - 3. Color: White.
  - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:
  - 1. <u>Manufacturers:</u> 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. <u>Childers Brand; H. B. Fuller Construction Products</u>.
    - b. <u>ITW Insulation Systems; Illinois Tool Works, Inc</u>.
  - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Factory cut and rolled to size.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.

- 6) Beveled collars.
- 7) Valve covers.
- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

# 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 11.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. 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. Width: 3 inches.
  - 2. Thickness: 6.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. 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. Width: 2 inches.
  - 2. Thickness: 6 mils.
  - 3. Adhesion: 64 ounces force/inch in width.
  - 4. Elongation: 500 percent.
  - 5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Width: 2 inches.
  - 2. Thickness: 3.7 mils.
  - 3. Adhesion: 100 ounces force/inch in width.
  - 4. Elongation: 5 percent.
  - 5. Tensile Strength: 34 lbf/inch in width.

# 2.10 SECUREMENTS

- A. Bands:
  - 1. 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.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

### 2.11 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers,:
  - 1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and coldwater supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures,:
  - 1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and coldwater supplies and trap and drain piping. Comply with 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. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- 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. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches] [4 inches] 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.
  - 4. 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. 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.
- D. Install removable insulation covers at valves, unions, strainers and flanges. 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 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.

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- 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.

#### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof

sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

#### 3.8 FINISHES

- A. 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.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

# 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

#### 3.10 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 PIPING INSULATION SCHEDULE
  - A. Reference plans.

#### 3.12 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. Reference plans for schedule.

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. Copper tube and fittings.
  - 2. Piping joining materials.
  - 3. Encasement for piping.
  - 4. Dielectric fittings.
- B. Related Requirements:

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.
- B. Sustainable Design Submittals:
  - 1. <u>Product Data</u>: For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

#### 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 and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.

2. Do not interrupt water service without Owner'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.
- C. Comply with NSF Standard 372 for low lead.

#### 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.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.

# 2.3 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

#### 2.4 TRANSITION FITTINGS

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.

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- 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

# 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 Unions:
  - 1. Standard: ASSE 1079.
  - 2. Pressure Rating: 125 psig minimum at 180 deg F.
  - 3. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  - 1. Standard: ASSE 1079.
  - 2. Factory-fabricated, bolted, companion-flange assembly.
  - 3. Pressure Rating: 125 psig minimum at 180 deg F.
  - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
  - 1. Nonconducting materials for field assembly of companion flanges.
  - 2. Pressure Rating: 150 psig.
  - 3. Gasket: Neoprene or phenolic.
  - 4. Bolt Sleeves: Phenolic or polyethylene.
  - 5. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
  - 1. Standard: IAPMO PS 66.
  - 2. Electroplated steel nipple complying with ASTM F 1545.
  - 3. Pressure Rating and Temperature: 300 psig at 225 deg F.
  - 4. End Connections: Male threaded or grooved.
  - 5. Lining: Inert and noncorrosive, propylene.

# PART 3 - EXECUTION

#### 3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

- C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level without pitch and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping to permit valve servicing.
- N. 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.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. 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."
- S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

- T. 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."
- U. 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."
- V. 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."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

# 3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints 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. 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.

# 3.3 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 unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

#### 3.4 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-58 and manufacturer's written instructions.

### 3.5 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.

### 3.6 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.

### 3.7 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.

# 3.8 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.
  - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

# 3.9 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 non-potable domestic water piping as follows:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of watersample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

# 3.10 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water piping, NPS 1/2 and smaller, shall be the following:
  - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

- E. Under-building-slab, domestic water, domestic water piping, NPS 3/4 to NPS 8 and larger , shall be the following:
  - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
  - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 6 Insert pipe size range, shall be the following:
  - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

#### 3.11 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
  - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
  - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
  - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116
# SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Balancing valves.
  - 5. Temperature-actuated, water mixing valves.
  - 6. Strainers.
  - 7. Outlet boxes.
  - 8. Hose bibbs.
  - 9. Drain valves.
  - 10. Water-hammer arresters.
  - 11. Air vents.
  - 12. Trap-seal primer systems.
  - 13. Specialty valves.
  - 14. Flexible connectors.
- B. Related Requirements:
  - 1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

# 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. 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 domestic water piping specialties to include in emergency, operation, and maintenance manuals.

# PART 2 - PRODUCTS

## 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G.

## 2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

## 2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Conbraco Industries, Inc</u>.
    - b. <u>FEBCO</u>.
    - c. <u>Watts; a Watts Water Technologies company</u>.
  - 2. Standard: ASSE 1001.
  - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
  - 4. Body: Bronze.
  - 5. Inlet and Outlet Connections: Threaded.
  - 6. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Conbraco Industries, Inc</u>.
    - b. <u>Watts; a Watts Water Technologies company</u>.
    - c. <u>Woodford Manufacturing Company</u>.
  - 2. Standard: ASSE 1011.
  - 3. Body: Bronze, nonremovable, with manual drain.
  - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.

- 5. Finish: Chrome or nickel plated.
- C. Pressure Vacuum Breakers:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. Ames Co.
    - b. <u>FEBCO</u>.
    - c. <u>Watts; a Watts Water Technologies company</u>.
  - 2. Standard: ASSE 1020.
  - 3. Operation: Continuous-pressure applications.
  - 4. Pressure Loss: 5 psig maximum, through middle third of flow range.
  - 5. Accessories:
    - a. Valves: Ball type, on inlet and outlet.

#### 2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Ames Co</u>.
    - b. <u>FEBCO</u>.
    - c. <u>Watts; a Watts Water Technologies company</u>.
  - 2. Standard: ASSE 1013.
  - 3. Operation: Continuous-pressure applications.
  - 4. Pressure Loss: 12 psig maximum, through middle third of flow range.
  - 5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
  - 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  - 7. Configuration: Designed for horizontal, straight-through or vertical flow.
  - 8. Accessories:
    - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Beverage-Dispensing-Equipment Reduced Pressure Zone Backflow Preventers:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:

- a. <u>Conbraco Industries, Inc</u>.
- b. <u>Watts; a Watts Water Technologies company</u>.
- 2. Standard: ASSE 1022.
- 3. Operation: Continuous-pressure applications.
- 4. Size: NPS 1/4 or NPS 3/8.
- 5. Body: Stainless steel.
- 6. End Connections: Threaded.

## 2.5 WATER PRESSURE-REDUCING VALVES

- A. Water Regulators:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Conbraco Industries, Inc</u>.
    - b. <u>Honeywell Water Controls</u>.
    - c. <u>Watts; a Watts Water Technologies company</u>.
  - 2. Standard: ASSE 1003.
  - 3. Pressure Rating: Initial working pressure of 150 psig.
  - 4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
  - 5. Valves for Booster Heater Water Supply: Include integral bypass.
  - 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

#### 2.6 BALANCING VALVES

- A. Cast-Iron Calibrated Balancing Valves:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Armstrong International, Inc</u>.
    - b. <u>ITT Corporation</u>.
    - c. <u>NIBCO INC</u>.
  - 2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
  - 3. Size: Same as connected piping, but not smaller than NPS 2-1/2.
  - 4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

## 2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Water-Temperature Limiting Devices:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Armstrong International, Inc</u>.
    - b. <u>Leonard Valve Company</u>.
    - c. <u>Powers</u>.
    - d. <u>Watts; a Watts Water Technologies company</u>.
  - 2. Standard: ASSE 1017.
  - 3. Pressure Rating: 125 psig.
  - 4. Type: Thermostatically controlled, water mixing valve.
  - 5. Material: Bronze body with corrosion-resistant interior components.
  - 6. Connections: Threaded union inlets and outlet.
  - 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperaturecontrol handle.
  - 8. Valve Finish: Chrome plated.
  - 9. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.
- B. Individual-Fixture, Water Tempering Valves:
  - 1. <u>Manufacturers:</u> 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. <u>Honeywell Water Controls</u>.
    - b. <u>Leonard Valve Company</u>.
    - c. <u>Powers</u>.
    - d. <u>Watts; a Watts Water Technologies company</u>.
  - 2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
  - 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
  - 4. Body: Bronze body with corrosion-resistant interior components.
  - 5. Temperature Control: Adjustable.
  - 6. Inlets and Outlet: Threaded.
  - 7. Finish: Rough or chrome-plated bronze.
- C. Y-Pattern Strainers:
  - 1. Pressure Rating: 125 psig minimum unless otherwise indicated.
  - 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
  - 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  - 4. Screen: Stainless steel with round perforations unless otherwise indicated.

- 5. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.062 inch.
  - b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
  - c. Strainers NPS 5 and Larger: 0.10 inch.
- 6. Drain: Factory-installed, hose-end drain valve.

#### 2.8 OUTLET BOXES

- A. Domestic Water Outlet Boxes (WB-1):
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Acorn Engineering Company</u>.
    - b. IPS Corporation.
    - c. <u>Oatey</u>.
  - 2. Mounting: Recessed.
  - 3. Material and Finish: Stainless-steel box and faceplate.
  - 4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
  - 5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

#### 2.9 HOSE BIBBS

- A. Hose Bibbs:
  - 1. Standard: ASME A112.18.1 for sediment faucets.
  - 2. Body Material: Bronze.
  - 3. Seat: Bronze, replaceable.
  - 4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
  - 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
  - 6. Pressure Rating: 125 psig.
  - 7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
  - 8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
  - 9. Finish for Service Areas: Rough bronze.
  - 10. Finish for Finished Rooms: Chrome or nickel plated.
  - 11. Operation for Equipment Rooms: Wheel handle or operating key.
  - 12. Operation for Service Areas: Wheel handle.
  - 13. Operation for Finished Rooms: Operating key.
  - 14. Recessed mounting box with locking cover.
  - 15. Include operating key with each operating-key hose bibb.
  - 16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.10 WALL HYDRANTS

- A. Nonfreeze Wall Hydrants (HB-1):
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg. Co.
    - b. Josam Company.
    - c. <u>Watts; a Watts Water Technologies company</u>.
    - d. <u>Woodford Manufacturing Company</u>.
  - 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
  - 3. Pressure Rating: 125 psig.
  - 4. Operation: Loose key.
  - 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
  - 6. Inlet: NPS 3/4 or NPS 1.
  - 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  - 8. Box: Deep, flush mounted with cover.
  - 9. Box and Cover Finish: Chrome plated.
  - 10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  - 11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
  - 12. Operating Keys(s): One with each wall hydrant.

## 2.11 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
  - 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
  - 2. Pressure Rating: 400-psig minimum CWP.
  - 3. Size: NPS 3/4.
  - 4. Body: Copper alloy.
  - 5. Ball: Chrome-plated brass.
  - 6. Seats and Seals: Replaceable.
  - 7. Handle: Vinyl-covered steel.
  - 8. Inlet: Threaded or solder joint.
  - 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
- B. Gate-Valve-Type, Hose-End Drain Valves:
  - 1. Standard: MSS SP-80 for gate valves.
  - 2. Pressure Rating: Class 125.
  - 3. Size: NPS 3/4.
  - 4. Body: ASTM B 62 bronze.

- 5. Inlet: NPS 3/4 threaded or solder joint.
- 6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
- C. Stop-and-Waste Drain Valves:
  - 1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
  - 2. Pressure Rating: 200-psig minimum CWP or Class 125.
  - 3. Size: NPS 3/4.
  - 4. Body: Copper alloy or ASTM B 62 bronze.
  - 5. Drain: NPS 1/8 side outlet with cap.

### 2.12 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters (WHA-"X":
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>AMTROL, Inc</u>.
    - b. Jay R. Smith Mfg. Co.
    - c. Josam Company.
    - d. <u>Precision Plumbing Products</u>.
    - e. Sioux Chief Manufacturing Company, Inc.
    - f. <u>Watts; a Watts Water Technologies company</u>.
  - 2. Standard: ASSE 1010 or PDI-WH 201.
  - 3. Type: Copper tube with piston.
  - 4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.13 AIR VENTS

- A. Bolted-Construction Automatic Air Vents:
  - 1. Body: Bronze.
  - 2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
  - 3. Float: Replaceable, corrosion-resistant metal.
  - 4. Mechanism and Seat: Stainless steel.
  - 5. Size: NPS 3/8 minimum inlet.
  - 6. Inlet and Vent Outlet End Connections: Threaded.
- B. Welded-Construction Automatic Air Vents:
  - 1. Body: Stainless steel.
  - 2. Pressure Rating: 150-psig minimum pressure rating.
  - 3. Float: Replaceable, corrosion-resistant metal.
  - 4. Mechanism and Seat: Stainless steel.
  - 5. Size: NPS 3/8 minimum inlet.

6. Inlet and Vent Outlet End Connections: Threaded.

#### 2.14 TRAP-SEAL PRIMER SYSTEMS

- A. Trap-Seal Primer Systems (TP-1):
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by the following:
    - a. <u>Precision Plumbing Products</u>.
  - 2. Standard: ASSE 1044.
  - 3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
  - 4. Cabinet: Recessed-mounted steel box with stainless-steel cover.
  - 5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
    - 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.
  - 6. Vacuum Breaker: ASSE 1001.
  - 7. Number Outlets: Sufficient to serve all drains in area plus minimum 2 capped and unused spares..
  - 8. Size Outlets: NPS 1/2.

## 2.15 SPECIALTY VALVES

A. Comply with requirements for general-duty metal valves in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

#### 2.16 FLEXIBLE CONNECTORS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
  - 1. <u>Flexicraft Industries</u>.
  - 2. <u>Hyspan Precision Products, Inc</u>.
  - 3. <u>Metraflex Company (The)</u>.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
  - 1. Working-Pressure Rating: Minimum 200 psig.
  - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.

3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

### PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- C. Install water-control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve water pressurereducing valve and pump.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fireretardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- H. Install water-hammer arresters in water piping according to PDI-WH 201.
- I. Install air vents at high points of water piping.
- J. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow. Provide trap primer to all floor drains regardless if shown on drawings.

### 3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

## 3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Pressure vacuum breakers.
  - 2. Intermediate atmospheric-vent backflow preventers.
  - 3. Reduced-pressure-principle backflow preventers.
  - 4. Carbonated-beverage-machine backflow preventers.
  - 5. Water pressure-reducing valves.
  - 6. Calibrated balancing valves.
  - 7. Primary, thermostatic, water mixing valves.
  - 8. Outlet boxes.
  - 9.
  - 10. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

#### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221123 - DOMESTIC WATER 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. Horizontally mounted, in-line, close-coupled centrifugal pumps.

#### 1.3 DEFINITIONS

A. 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.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Sustainable Design Submittals:
  - 1. <u>Product Data</u>: For pump controls.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.
- 1.6 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

- 1.7 DELIVERY, STORAGE, AND HANDLING
  - A. Retain shipping flange protective covers and protective coatings during storage.
  - B. Protect bearings and couplings against damage.
  - C. Comply with pump manufacturer's written rigging instructions for handling.
- 1.8 COORDINATION
  - A. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### PART 2 - PRODUCTS

- 2.1 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS (CP-1)
  - A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - 1. <u>Armstrong Pumps, Inc</u>.
    - 2. <u>Bell & Gossett; a Xylem brand</u>.
    - 3. PACO Pumps; Grundfos Pumps Corporation, USA.
  - B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhungimpeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontally.
  - C. Pump Construction:
    - 1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
    - 2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
    - 3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
    - 4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
    - 5. Bearings: Oil-lubricated; bronze-journal or ball type.
    - 6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
  - D. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.
  - E. Capacities and Characteristics:

- 1. Capacity: 5 gpm.
- 2. Total Dynamic Head: 8 feet.
- 3. Casing Material: Lead free bronze.
- 4. Impeller Material: Lead free brass.
- 5. Minimum Working Pressure: 175 psig.
- 6. Maximum Continuous Operating Temperature: 225 deg F.
- 7. Inlet and Outlet Size:  $\frac{3}{4}$  NPS.
- 8. Pump Control: Time clock and aquastat.
- 9. Pump Speed: 1725 rpm.
- 10. Motor Horsepower: 1/12.
- 11. Electrical Characteristics:
  - a. Volts: 120.
  - b. Phases: Single.
  - c. Hertz: 60.
  - d. Full-Load Amperes: 1.75.

#### 2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## 2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
  - 1. Type: Water-immersion temperature sensor, for installation in piping.
  - 2. Range: 65 to 200 deg F.
  - 3. Enclosure: NEMA 250, Type 4X.
  - 4. Operation of Pump: On or off.
  - 5. Settings: Start pump at 105 deg F and stop pump at 115 deg F.
- B. Timers: Electric, for control of hot-water circulation pump.
  - 1. Type: Programmable, seven-day clock with manual override on-off switch.
  - 2. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
  - 3. Operation of Pump: On or off.
  - 4. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.
- 3.2 PUMP INSTALLATION
  - A. Comply with HI 1.4.
  - B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
  - C. Install horizontally mounted, in-line, close-coupled centrifugal pumps with shaft(s) horizontal.
  - D. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support pump weight.
    - 1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
    - 2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - E. Install pressure switches in water supply piping.
  - F. Install thermostats in hot-water return piping.
  - G. Install timers adjacent to pump.
  - H. Timer and thermostat shall be wired in series.

## 3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
  - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
    - a. Horizontally mounted, in-line, close-coupled centrifugal pumps.
    - b. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."

- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."
  - 1. Install pressure gage and snubber at suction of each pump and pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- E. Connect thermostats, and timers to pumps that they control.

# 3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

## 3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers on suction piping.
  - 4. Set thermostats and timers, for automatic starting and stopping operation of pumps.
  - 5. Perform the following startup checks for each pump before starting:
    - a. Verify bearing lubrication.
    - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    - c. Verify that pump is rotating in the correct direction.
  - 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  - 7. Start motor.
  - 8. Open discharge valve slowly.
  - 9. Adjust temperature settings on thermostats.
  - 10. Adjust timer settings.

#### 3.6 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123

# SECTION 221316 - SANITARY WASTE AND VENT PIPING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipe, tube, and fittings.
  - 2. Specialty pipe fittings.

## 1.2 INFORMATIONAL SUBMITTALS

- A. Field quality-control and test reports.
- 1.3 QUALITY ASSURANCE
  - A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
  - B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

## 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 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301. All cast iron pipe and fittings shall be manufactured in the United States.
- B. Heavy-Duty, Hubless-Piping Couplings:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>ANACO-Husky</u>.
    - b. <u>Charlotte Pipe and Foundry Company</u>.
    - c. <u>MIFAB, Inc</u>.

- 2. Standards: ASTM C 1277 and ASTM C 1540.
- 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

# 2.3 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, drawn temper.
- B. Copper Pressure Fittings:
  - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

#### 2.4 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.
  - 3. Shielded, Nonpressure Transition Couplings:
    - a. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
      - 1) <u>Cascade Waterworks Mfg. Co.</u>
      - 2) <u>Mission Rubber Company; a division of MCP Industries, Inc.</u>
    - b. Standard: ASTM C 1460.
    - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

# PART 3 - EXECUTION

#### 3.1 EARTH MOVING

A. Comply with requirements in other sections of these specifications for excavating, trenching, and backfilling.

## 3.2 PLENUM PIPING

A. With the approval of the jurisdiction having authority, piping located in return air plenums may be plastic and shall be wrapped with noncombustible insulation with 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.

## 3.3 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. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

- 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
- Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
- 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- K. 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."
- L. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install cleanouts located not more than 100 feet apart, at changes in direction greater than 45 degrees and at the base of each waste or soil stack.
  - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- 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.

## 3.4 JOINT CONSTRUCTION

A. 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.

## 3.5 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in OD's.
  - 2. In Drainage Piping: Shielded, nonpressure transition couplings.

# 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 stainless-steel pipe hangers for horizontal piping in corrosive environments.
- 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
- 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
- 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
- 6. Install individual, straight, horizontal piping runs:
  - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
  - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
  - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
- 7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, 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 (10-mm) 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 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
  - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
  - 4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
  - 5. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. 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. Install horizontal backwater valves in pit with pit cover flush with floor.
  - 6. Comply with requirements for backwater valves, cleanouts, and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
  - Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

## 3.8 IDENTIFICATION

A. Identify 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 closingin after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.
- 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.
  - D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

## 3.11 PIPING SCHEDULE

- A. Aboveground, soil and waste piping shall be the following:
  - 1. Hubless cast-iron soil pipe and fittings heavy-duty, shielded, stainless-steel couplings; and hubless-coupling joints.
- B. Aboveground, vent piping shall be any of the following:
  - 1. Hubless cast-iron soil pipe and fittings standard, shielded, stainless-steel couplings; and hubless-coupling joints.

- C. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be any of the following:
  - 1. Hubless cast-iron soil pipe and fittings; heavy-duty, shielded, stainless-steel couplings; and hubless-coupling joints.
- D. Underground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:
  - 1. Hubless cast-iron soil pipe and fittings; heavy-duty, shielded, stainless-steel couplings; and hubless-coupling joints.

END OF SECTION 221316

# SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Cleanouts.
  - 2. Floor drains.
  - 3. Floor sinks.
  - 4. Roof flashing assemblies.
  - 5. Miscellaneous sanitary drainage piping specialties.
  - 6. Flashing materials.

## 1.2 ACTION SUBMITTALS

- A. Product Data for Grease Interceptors: Include rated capacities, operating characteristics, and accessories for grease interceptors.
- 1.3 QUALITY ASSURANCE
  - A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

# PART 2 - PRODUCTS

# 2.1 CLEANOUTS

- A. Exposed Cast-Iron Cleanouts:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company.
    - b. <u>MIFAB, Inc</u>.
    - c. <u>Smith, Jay R. Mfg. Co</u>.
    - d. <u>Tyler Pipe</u>.
    - e. Wade
    - f. <u>Watts Drainage Products</u>.
    - g. Zurn Plumbing Products Group.
  - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
  - 3. Size: Same as connected drainage piping

- 4. Body Material: Hubless, cast-iron soil pipe test tee] as required to match connected piping.
- 5. Closure: Countersunk cast-iron plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Floor Cleanouts:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.
    - b. <u>Oatey</u>.
    - c. <u>Sioux Chief Manufacturing Company, Inc</u>.
    - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - e. <u>Tyler Pipe; Wade Div</u>.
    - f. Wade
    - g. <u>Watts Drainage Products Inc</u>.
    - h. Zurn Plumbing Products Group; Light Commercial Operation.
    - i. Zurn Plumbing Products Group; Specification Drainage Operation.
  - 2. Standard: ASME A112.36.2M for adjustable housing cleanout.
  - 3. Size: Same as connected branch.
  - 4. Type: Cast-iron soil pipe with cast-iron ferrule.
  - 5. Body or Ferrule: Cast iron.
  - 6. Outlet Connection: Threaded.
  - 7. Closure: Brass plug with tapered threads.
  - 8. Adjustable Housing Material: Cast iron with threads.
  - 9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
  - 10. Frame and Cover Shape: Round.
- C. Cast-Iron Wall Cleanouts:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.
    - b. <u>MIFAB, Inc</u>.
    - c. <u>Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc</u>.
    - d. <u>Tyler Pipe; Wade Div</u>.
    - e. Wade
    - f. <u>Watts Drainage Products Inc.</u>
    - g. Zurn Plumbing Products Group; Specification Drainage Operation.
  - 2. Standard: ASME A112.36.2M. Include wall access.
  - 3. Size: Same as connected drainage piping.
  - 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
  - 5. Closure: Countersunk brass plug.
  - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
  - 7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

## 2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Commercial Enameling Co.</u>
    - b. Josam Company; Josam Div.
    - c. <u>MIFAB, Inc</u>.
    - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - e. <u>Tyler Pipe; Wade Div</u>.
    - f. Wade
    - g. <u>Watts Drainage Products Inc</u>.
    - h. Zurn Plumbing Products Group; Specification Drainage Operation.
  - 2. Standard: ASME A112.6.3.
  - 3. Pattern: Floor and funnel floor (see drawings)
  - 4. Body Material: Cast iron
  - 5. Seepage Flange: Required
  - 6. Clamping Device: Required.
  - 7. Outlet: Bottom.
  - 8. Backwater Valve: Not Required
  - 9. Coating on Interior and Exposed Exterior Surfaces: Not Required
  - 10. Sediment Bucket: Not Required
  - 11. Top or Strainer Material: Nickel bronze.
  - 12. Top Shape: Square in tiled areas, round in all others.
  - 13. Sheet Flooring Clamping Strainer Flange: Required in areas with sheet flooring.
  - 14. Top Loading Classification: Heavy duty.
  - 15. Funnel: Required on certain locations; see drawings.
  - 16. Trap Features: Trap-seal primer valve drain connection.

# 2.3 FLOOR SINKS

- A. Cast-Iron Floor Sinks:
  - 1. Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Watts Drainage Products Inc.
    - e. Zurn Plumbing Products Group; Specification Drainage Operation.
  - 2. Standard: ASME A112.6.3.
  - 3. Receptor: Cast iron, flanged, with seepage holes, acid resistant coated interior
  - 4. Rim: Nickel bronze
  - 5. Grate: <sup>1</sup>/<sub>2</sub>.

- 6. Sump Depth: 6-1/2".
- 7. Trap Primer Connection:  $\frac{1}{2}$ "
- 8. Body Material: Cast iron.
- 9. Clamping Device: Required.
- 10. Outlet: Bottom.
- 11. Backwater Valve: Not required.
- 12. Bucket Liner: Stainless Steel.
- 13. Top or Strainer Material: Satin Nickel Bronze.
- 14. Top Shape: Square
- 15. Sheet Flooring Clamping Strainer Flange: Required in areas with sheet flooring.
- 16. Top Loading Classification: Heavy duty.

## 2.4 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn Engineering Company; Elmdor/Stoneman Div.
    - b. <u>Thaler Metal Industries Ltd.</u>
  - 2. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch-(1.6-mm-) thick, lead flashing collar and skirt extending at least 6 inches (150 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
    - a. Open-Top Vent Cap: Without cap.
    - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
    - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

## 2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Floor-Drain, Trap-Seal Primer Fittings:
  - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
  - 2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.
- B. Air-Gap Fittings:
  - 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
  - 2. Body: Bronze or cast iron.
  - 3. Inlet: Opening in top of body.
  - 4. Outlet: Larger than inlet.
  - 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

- C. Sleeve Flashing Device:
  - 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
  - 2. Size: As required for close fit to riser or stack piping.
- D. Stack Flashing Fittings:
  - 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
  - 2. Size: Same as connected stack vent or vent stack.
- E. Vent Caps:
  - 1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
  - 2. Size: Same as connected stack vent or vent stack.

#### 2.6 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
  - 1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
  - 2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
  - 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## 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 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.

# SANITARY WASTE PIPING SPECIALTIES

- 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
- 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
    - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
    - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
  - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Size: Same as floor drain inlet.
- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- J. Install vent caps on each vent pipe passing through roof.
- K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

## 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. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according other sections of the specifications.
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

## 3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.5 **PROTECTION**

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

## SECTION 221323 - SANITARY WASTE INTERCEPTORS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Hydromechanical grease interceptors.

# 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of interceptor.
- B. Shop Drawings: For each type and size of precast concrete interceptor indicated.
  - 1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Interceptors, drawn to scale, and coordinated with each other, using input from installers of the items involved:
  - 1. Piping connections. Include size, location, and elevation of each.
  - 2. Interface with underground structures and utility services.

## PART 2 - PRODUCTS

# 2.1 HYDROMECHANICAL GREASE INTERCEPTORS

- A. Seamless Rotationally-molded HDPE Hydromechanical Grease Interceptor: IAPMO listed to comply with ASME A112.14.3 (Type C) and CSA B481.1.
  - 1. Extension Riser: Total length to allow mounting flush with floor, to match diameter of frame and cover.
- B. Seamless Rotationally-molded HDPE Sampling Port: Built in accordance with Water Environment Federation's "Standard Methods for Examination of Water and Waste Water" with sealed top access port, highway rated composite cover and field adjustable riser.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

### 3.2 INSTALLATION

- A. Install interceptors according to manufacturer's instructions.
- B. Set interceptors level and plumb.
- C. Install risers from top of underground interceptors to openings and gratings at finished floor.
- D. Set tops of grating frames and grates flush with finished surface.
- E. Set plastic interceptors level and plumb.
- F. Install grease interceptors, including trapping, sampling port, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
  - 1. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
  - 2. Install cleanout immediately downstream from sampling port not having integral cleanout on outlet.
  - 3. Install monitoring port downstream from interceptor.

#### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make piping connections between interceptors and piping systems.

#### 3.4 IDENTIFICATION

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Grease interceptors.

# END OF SECTION 221323
## SECTION 221413 - STORM DRAINAGE PIPING

## PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following storm drainage piping inside the building:
  - 1. Pipe, tube, and fittings.
  - 2. Special pipe fittings.
  - 3. Encasement for underground metal piping.

# 1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum workingpressure, unless otherwise indicated:
  - 1. Storm Drainage Piping: 30-foot head of water.

## 1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

# PART 2 - PRODUCTS

## 2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

## 2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class. All cast iron pipe and fittings shall be manufactured in the United States.
- 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. All cast iron pipe and fittings shall be manufactured in the United States.
- B. Heavy-Duty, Hubless-Piping Couplings:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>ANACO-Husky</u>.
    - b. <u>Charlotte Pipe and Foundry Company</u>.
    - c. <u>MIFAB, Inc</u>.
  - 2. Standards: ASTM C 1277 and ASTM C 1540.
  - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.4 ABS PIPE AND FITTINGS

- A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
- B. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
- C. Solvent Cement: ASTM D 2235.
  - 1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

#### 2.5 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. 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).
- 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. 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. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

# PART 3 - EXECUTION

# 3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in other sections of these specifications.

# 3.2 PLENUM PIPING

A. With the approval of the jurisdiction having authority, piping located in return air plenums may be plastic and shall be wrapped with noncombustible insulation with 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.

# 3.3 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 from 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 storm drainage piping using appropriate branches, bends, and long-sweep bends. 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 storm 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. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Storm Drain: 1 percent downward in direction of flow unless noted otherwise on the plans.
  - 2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow unless noted otherwise on the plans.
- K. 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.
- L. Install underground ABS and PVC piping according to ASTM D 2321.
- M. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
  - 2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors.
- P. Install sleeve seals for piping penetrations of concrete walls and slabs.
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.

## 3.4 JOINT CONSTRUCTION

- A. 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.
- B. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

# 3.5 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in OD's.
  - 2. In Drainage Piping: Shielded, nonpressure transition couplings.

## 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. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
  - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) 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 (300 mm) of each fitting, valve, 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 (10-mm) 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 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
- 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
- 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
- 4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
- 5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
- 6. Spacing for 10-foot (3-m) pipe lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
  - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
  - 4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
  - 5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- H. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).
- I. 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 interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
  - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

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# 3.8 IDENTIFICATION

A. Identify storm drainage 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.
  - 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 storm drainage 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 storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 5. Prepare reports for tests and required corrective action.

# 3.10 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

## 3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 6 (DN 150) and smaller shall be any of the following:
  - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
- C. Aboveground, storm drainage piping NPS 8 (DN 200) and larger shall be any of the following:
  - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
- D. Underground storm drainage piping NPS 6 (DN 150) 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; heavy duty hubless-piping couplings; and coupled joints.
  - 3. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
  - 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Underground, storm drainage piping NPS 8 (DN 200) and larger shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless, cast-iron soil pipe and fittings; cast-iron, heavy duty hubless-piping couplings; and coupled joints.
  - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 4. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.

END OF SECTION 221413

# SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

# PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Commercial, electric, storage, domestic-water heaters.
  - 2. Commercial, light-duty, storage, electric, domestic-water heaters.
  - 3. Domestic-water heater accessories.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Sustainable Design Submittals:
  - 1. <u>Product Data</u>: For energy efficiency.
- C. Shop Drawings:
  - 1. Wiring Diagrams: For power, signal, and control wiring.

#### 1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.

- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.
- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Warranty: Sample of special warranty.

# 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.
- 1.7 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. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
    - 1. <u>Comply with efficiency requirements in</u> ASHRAE 189.1, which supersede requirements in ASHRAE/IESNA 90.1.
  - C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  - D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components Health Effects."

# 1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Commercial, Electric, Storage, Domestic-Water Heaters:
      - 1) Storage Tank: Three years.
      - 2) Controls and Other Components: Three years.
    - b. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
      - 1) Storage Tank: Three years.
      - 2) Controls and Other Components: Two Three years.
    - c. Compression Tanks: Five years.

# PART 2 - PRODUCTS

# 2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters (EWH-1):
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Rheem Manufacturing Company</u>.
    - b. Smith, A. O. Corporation.
    - c. <u>State Industries</u>.
  - 2. Standard: UL 1453.
  - 3. Storage-Tank Construction: ASME-code, steel vertical arrangement.
    - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
      - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

- b. Pressure Rating: 150 psig.
- c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining material into tappings.
- 4. Factory-Installed Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
  - c. Insulation: Comply with ASHRAE/IESNA 90.1.
  - d. Jacket: Steel with enameled finish.
  - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
  - f. Temperature Control: Adjustable thermostat.
  - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
  - h. Relief Valves: ASME rated and stamped for combination temperature-andpressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- 5. Special Requirements: NSF 5 construction.
- B. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters (EWH-2):
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Bradford White Corporation</u>.
    - b. <u>Rheem Manufacturing Company</u>.
    - c. <u>Smith, A. O. Corporation</u>.
  - 2. Standard: UL 174.
  - 3. Storage-Tank Construction: Steel, vertical arrangement.
    - a. Tappings: ASME B1.20.1 pipe thread.
    - b. Pressure Rating: 150 psig.
    - c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining material into tappings.
  - 4. Factory-Installed Storage-Tank Appurtenances:
    - a. Anode Rod: Replaceable magnesium.
    - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
    - c. Drain Valve: ASSE 1005.
    - d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
    - e. Jacket: Steel with enameled finish.
    - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
    - g. Heating Elements: One; electric, screw-in immersion type. Limited to 12 kW total.
    - h. Temperature Control: Adjustable thermostat.

- i. Safety Control: High-temperature-limit cutoff device or system.
- j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
- 5. Special Requirements: NSF 5 construction with legs for off-floor installation.
- C. Capacity and Characteristics (EWH-1):
  - 1. Capacity: 100 gallons.
  - 2. Recovery: 49 gph at 100 deg F temperature rise.
  - 3. Temperature Setting: 125 deg F.
  - 4. Power Demand: 12 kW.
  - 5. Heating Elements:
    - a. Number of Elements: Three.
  - 6. Electrical Characteristics:
    - a. Volts: 480.
    - b. Phases: Three.
    - c. Hertz: 60.
- D. Capacity and Characteristics (EWH-2):
  - 1. Capacity: 6 gal.
  - 2. Recovery: 10 gph at 100 deg F temperature rise.
  - 3. Temperature Setting: 140 deg F.
  - 4. Power Demand: 2.5 kW.
  - 5. Heating Elements:
    - a. Number of Elements: One.
  - 6. Electrical Characteristics:
    - a. Volts: 120.
    - b. Phases: Single.
    - c. Hertz: 60.

# 2.2 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Compression Tanks:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>AMTROL, Inc</u>.
    - b. <u>Smith, A. O. Corporation</u>.

- c. <u>State Industries</u>.
- 2. Description: Steel pressure-rated tank constructed with welded joints and factoryinstalled butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
- 3. Construction:
  - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
  - b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
  - c. Air-Charging Valve: Factory installed.
- 4. Capacity and Characteristics (Serves EWH-1):
  - a. Working-Pressure Rating: 150 psig.
  - b. Capacity Acceptable: 4 gal. minimum.
- 5. Capacity and Characteristics (Serves (EWH-2):
  - a. Working-Pressure Rating: 150 psig.
  - b. Capacity Acceptable: 2 gal. minimum.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- C. Heat-Trap Fittings: ASHRAE 90.2.
- D. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domesticwater heater working-pressure rating.
- E. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- F. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- 2.3 SOURCE QUALITY CONTROL
  - A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
  - B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
  - C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

# PART 3 - EXECUTION

# 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base with insulation base.
  - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
  - 2. Maintain manufacturer's recommended clearances.
  - 3. Arrange units so controls and devices that require servicing are accessible.
  - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 8. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
  - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- C. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

- G. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- I. Fill electric, domestic-water heaters with water.
- J. Charge domestic-water compression tanks with air.

## 3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

## 3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

# 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

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# 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters.

END OF SECTION 223300

SECTION 224000 - PLUMBING FIXTURES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
  - 1. Faucets for lavatories and sinks.
  - 2. Toilet seats.
  - 3. Protective shielding guards.
  - 4. Fixture supports.
  - 5. Water closets.
  - 6. Urinals.
  - 7. Lavatories.
  - 8. Service sinks.
  - 9. Multi-Station Wash Fountains
- B. Related Sections include the following:
  - 1. Division 22 Section "Domestic water piping specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

# 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

# 1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

- 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Where applicable comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
  - 2. Plastic Laundry Trays: ANSI Z124.6.
  - 3. Plastic Shower Enclosures: ANSI Z124.2.
  - 4. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
  - 5. Slip-Resistant Bathing Surfaces: ASTM F 462.
  - 6. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
  - 7. Stainless-Steel Residential Sinks: ASME A112.19.3.
  - 8. Vitreous-China Fixtures: ASME A112.19.2M.
  - 9. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
  - 10. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Where applicable comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
  - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
  - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
  - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
  - 4. Faucets: ASME A112.18.1.
  - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
  - 6. Hose-Coupling Threads: ASME B1.20.7.
  - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  - 8. NSF Potable-Water Materials: NSF 61.
  - 9. Pipe Threads: ASME B1.20.1.
  - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.

- 11. Supply Fittings: ASME A112.18.1.
- I. Brass Waste Fittings: ASME A112.18.2. Comply with the following applicable standards and other requirements specified for bathtub, bathtub/shower, and shower faucets:
  - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
  - 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
  - 3. Faucets: ASME A112.18.1.
  - 4. Hand-Held Showers: ASSE 1014.
  - 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
  - 6. Hose-Coupling Threads: ASME B1.20.7.
  - 7. Manual-Control Antiscald Faucets: ASTM F 444.
  - 8. Pipe Threads: ASME B1.20.1.
  - 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
  - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
  - 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- J. Where applicable comply with the following applicable standards and other requirements specified for miscellaneous fittings:
  - 1. Atmospheric Vacuum Breakers: ASSE 1001.
  - 2. Brass and Copper Supplies: ASME A112.18.1.
  - 3. Dishwasher Air-Gap Fittings: ASSE 1021.
  - 4. Manual-Operation Flushometers: ASSE 1037.
  - 5. Plastic Tubular Fittings: ASTM F 409.
  - 6. Brass Waste Fittings: ASME A112.18.2.
  - 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- K. Where applicable comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Disposers: ASSE 1008 and UL 430.
  - 2. Dishwasher Air-Gap Fittings: ASSE 1021.
  - 3. Flexible Water Connectors: ASME A112.18.6.
  - 4. Grab Bars: ASTM F 446.
  - 5. Hose-Coupling Threads: ASME B1.20.7.
  - 6. Hot-Water Dispensers: ASSE 1023 and UL 499.
  - 7. Off-Floor Fixture Supports: ASME A112.6.1M.
  - 8. Pipe Threads: ASME B1.20.1.
  - 9. Plastic Toilet Seats: ANSI Z124.5.
  - 10. Supply and Drain Protective Shielding Guards: ICC A117.1.

#### 1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: One year from date of Substantial Completion.
- 2. Warranty shall include a 1 year labor warranty.

## PART 2 - PRODUCTS

# 2.1 SEE PLUMBING FIXTURE SCHEDULE ON PLANS FOR REQUIRED FIXTURES FOR THIS PROJECT.

#### 2.2 LAVATORY FAUCETS

- A. Lavatory Faucets, L-1:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard Companies, Inc.
    - b. Chicago Faucets.
    - c. Sloan Valve
  - 2. Description: DC powered, sensor activated electronic hand washing faucet for tempered or hot/cold water operation
    - a. Standard: ADA Compliant; ASME A112.18.1-2005
    - b. Body Material: Commercial, solid brass.
    - c. Finish: Chrome plated
    - d. Maximum Flow: 0.5 gpm
    - e. Centers: Single
    - f. Mounting: Deck, concealed with trim plate and anti-rotation pin
    - g. Inlet(s): NPS 1/2 male shank.
    - h. Spout: Integral.
    - i. Spout Outlet: Aerator, vandal resistant.
    - j. Operation: DC-powered infrared sensor with solenoid valve, DC power convertor.

# 2.3 COMMERCIAL SINK FAUCETS

- A. Sink Faucets, S-1:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Moen
    - b. Chicago Faucets
  - 2. Description: Concession Sink. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

- a. Standard: ADA ANSI/ICC A117.1, ASME A112.18.1/CSA B125.1
- b. Body Material: Commercial, solid brass, lead free.
- c. Finish: Chrome plate.
- d. Maximum Flow Rate: 1.5 gpm, unless otherwise indicated.
- e. Centers: 8 inches.
- f. Mounting: Deck
- g. Handle(s): 4" Vandal Resistant Wristblade
- h. Inlet(s): NPS 1/2 male shank.
- i. Spout Type: 3-1/2" Rigid/Swing Gooseneck
- j. Spout Outlet: Pressure compensating Softflow aerator.
- k. Operation: Quarter turn operating cartridge, lead free.
- l. Tempering Device: Manual.
- B. Sink Faucets, S-2:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Moen
    - b. Chicago Faucets
  - 2. Description: Triple Compartment Sink. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
    - a. Standard: ADA ANSI/ICC A117.1, ASME A112.18.1/CSA B125.1
    - b. Body Material: Commercial, solid brass, lead free.
    - c. Finish: Chrome plate.
    - d. Maximum Flow Rate: 1.5 gpm, unless otherwise indicated.
    - e. Centers: 8 inches.
    - f. Mounting: Deck
    - g. Handle(s): 4" Vandal Resistant Wristblade
    - h. Inlet(s): NPS 1/2 male shank.
    - i. Spout Type: 13" double jointed, integral vacuum breaker.
    - j. Spout Outlet: Pressure compensating Softflow aerator.
    - k. Operation: Quarter turn operating cartridge, lead free.
- C. Tempering Device: Manual.

## 2.4 SERVICE SINK FAUCETS

- A. Service Sink Faucet, MS-1:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    - a. Moen
    - b. Chicago Faucets.

- 2. Description: Wall mounted concealed fittings service faucet for service sink type fixture. Include body with corrosion-resistant internal components, integral stop valves, copper or brass tubing, and polished chrome-plated finish on exposed parts.
  - a. Standard: ADA ANSI/ICC A117.1, ASME A112.18.1.
  - b. Internal Design: Quarter turn compression cartridge
  - c. Style: Exposed.
  - d. Inlet Sizes: NPS 3/4" Female thread
  - e. Vacuum Breaker: Atmospheric

## 2.5 ICE MAKER BOXES

- A. Ice Maker Fixture, IMF-1:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    - a. Guy Gray
    - b. Approved Equal
  - 2. Description: Galvanized ice maker outlet box with lead free quarter turn valve
    - a. Standard: ASME A112.18.1
    - b. Box Material: G90 Hot Dipped Galvanized Steel (unpainted); 20 gauge box with 20 gauge faceplate
    - c. Valve Kit: Lead-free quarter turn valve kit with NPS 1/2" connection

## 2.6 TOILET SEATS

- A. Toilet Seats, WC-1, WC-2:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard Companies, Inc.
    - b. Bemis Manufacturing Company.
    - c. Church Seats.
    - d. Comfort Seats.
    - e. Eljer.
    - f. Kohler Co.
    - g. Toto
    - h. Olsonite Corp.
  - 2. Description: Toilet seat for water-closet-type fixture.
    - a. Standard: IAPMO/ANSI Z124.5, ADA Compliant with ADA water closet.
    - b. Material: Molded, solid plastic with antimicrobial agent.
    - c. Configuration: Elongated, open front without cover.

- d. Hinge Type: SC, self-sustaining, check.
- e. Rating: Heavy Duty

# 2.7 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Piping Covers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Engineered Brass Co.
    - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
    - c. McGuire Manufacturing Co., Inc.
    - d. Plumberex Specialty Products Inc.
    - e. TCI Products.
    - f. TRUEBRO, Inc.
    - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
  - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

#### 2.8 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Josam Company.
  - 2. Smith, Jay R. Mfg. Co.
  - 3. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
  - 4. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Water-Closet Supports:
  - 1. Description: Combination carrier designed for wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
- C. Urinal Supports:
  - 1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
  - 2. Accessible-Fixture Support: Include rectangular steel uprights.
- D. Lavatory Supports:

- 1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
- 2. Accessible-Fixture Support: Include rectangular steel uprights.

# 2.9 WATER CLOSETS

- A. Water Closets, WC-1, WC-2:
  - 1. Description: Wall-mounted back outlet, top spud.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard Companies, Inc.
    - b. Crane Plumbing, L.L.C./Fiat Products.
    - c. Kohler Co.
    - d. Sloan
    - e. Toto
    - f. Zurn Plumbing Products Group; Commercial Brass Operation.
  - 3. Refer to plan for specification of fixture including height, accessories, etc.
  - 4. Bowl:
    - a. Standards: ASME A112.19.2/CSA B45.1, ADA Compliant
    - b. Material: Vitreous china.
    - c. Type: Siphon jet.
    - d. Flush valve: Required.
    - e. Rim Contour: Elongated.
    - f. Water Consumption: 1.28 gal. per flush.
    - g. Spud Size and Location: NPS 1-1/2 (DN 40); top.
    - h. Color: White.
  - 5. Bowl-to-Drain Connecting Fitting: ASTM A 1045 or ASME A112.4.3.

## 2.10 WATER CLOSET FLUSHOMETER VALVES

- A. Flushometers, WC-1, WC-2:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Sloan Valve Company.
    - b. Toto
    - c. Kohler Co.
    - d. Zurn Plumbing Products Group; Commercial Brass Operation.
  - 2. Standard: ASSE 1037, ASME A112.18.1, ADA Compliant
  - 3. Maximum Pressure Rating: 80 psig
  - 4. Material: Brass body with corrosion-resistant components.

- 5. Exposed Flushometer-Valve Finish: Chrome plated.
- 6. Style: Exposed.
- 7. Consumption: 1.28 gal. (4.8 L) per flush.
- 8. Minimum Inlet: NPS 1-1/2 (DN 25).
- 9. Minimum Outlet: NPS 1-1/2 (DN 32).

## 2.11 URINALS

- A. Urinals, UR-1:
  - 1. Refer to plan for specification of fixture including accessories, etc.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard Companies, Inc.
    - b. Crane Plumbing, LLC/Fiat Products.
    - c. Kohler Co.
    - d. Sloan
    - e. Toto
    - f. Zurn Plumbing Products Group; Commercial Brass Operation.
  - 3. Description: Wall-mounting, vitreous-china fixture designed for flushometer valve operation.
    - a. Standards: ASME A112.19.2/CSA B45.1, ADA Compliant, ICC/ANSI A117.1
    - b. Material: Vitreous china.
    - c. Water Consumption: 0.125 gpf
    - d. Spud Size and Location: NPS 3/4 (DN 20); top.
    - e. Outlet Size and Location: NPS 2 (DN 50); bottom.
    - f. Color: White.
  - 4. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

# 2.12 URINAL FLUSHOMETER VALVES

- A. Flushometers, UR-1:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Sloan Valve Company.
    - b. Toto.
    - c. Kohler Co.
    - d. Zurn Plumbing Products Group; Commercial Brass Operation.

- 2. Standard: ASSE 1037, ADA Compliant
- 3. Minimum Pressure Rating: 25-80 psig.
- 4. Material: Brass body with corrosion-resistant components.
- 5. Exposed Flushometer-Valve Finish: Chrome plated.
- 6. Style: Exposed.
- 7. Consumption: 0.125 gal. per flush.
- 8. Minimum Inlet: NPS 3/4 (DN 20).
- 9. Minimum Outlet: NPS 3/4 (DN 20).

#### 2.13 LAVATORIES

- A. Lavatories, L-1:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard Companies, Inc.
    - b. Crane Plumbing, L.L.C./Fiat Products.
    - c. Kohler Co.
    - d. Sloan
    - e. Toto
    - f. Zurn Plumbing Products Group; Commercial Brass Operation.
  - 2. Description: Accessible, wall-mounted vitreous china lavatory
    - a. Standard: ASME A112.19.2/CSA B45.1, ADA Compliant
    - b. Type: Ledge back
    - c. Size: 23"x20"x6"
    - d. Faucet Hole Punching: One hole, centered
    - e. Faucet-Hole Location: Top.
    - f. Color: White.
    - g. Faucet: One, Required.
    - h. Supplies: NPS 3/8 chrome-plated copper with stops.
    - i. Drain: Grid.
    - j. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated, cast-brass P-trap with cleanout plug; NPS 1-1/2 (DN40) thick tubular brass waste to wall; and wall escutcheon.
    - k. Mounting Material: Sealant.

## 2.14 COMMERCIAL SINKS

- A. Commercial Classroom Sinks, S-1:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Tabco.
    - b. Elkay Manufacturing Co.

- c. Just Manufacturing Company.
- 2. Description: One-compartment, counter-mounting, stainless-steel commercial, classroom sink
  - a. Overall Dimensions: 25x17".
  - b. Compartment:
    - 1) Dimensions: 22"x19-1/2"x6-1/2".
    - 2) Drain: Elkay LK35
      - a) Stainless steel body and removable conical basket strainer
      - b) Metal stem
      - c) Rubber stopper
      - d) Location: Centered in rear of compartment.
  - c. Faucet(s): Required.
    - 1) Number Required: One.
    - 2) Mounting: Back ledge.
  - d. Construction: Seamless die-drawn, 20 gauge type 304 stainless steel. Self-rimming top with stainless steel mounting channels. Fully coated underside for sound deadening and condensation reduction.
  - e. Supplies: NPS 1/2 chrome-plated copper with loose key angle stops.
  - f. Drain Piping: NPS 1 1/2 chrome-plated, cast-brass P-trap with cleanout plug; 0.045-inch- thick tubular brass waste to wall; and wall escutcheon(s).
  - g. Standard: ADA ANSI/ICC A117.1, ASME A112.19.3/CSA B45.4.
- B. Triple Compartment Sinks, S-2:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Tabco.
    - b. BK Resources.
    - c. Just Manufacturing Company.
  - 2. Description: Triple-compartment, counter-mounting, stainless-steel commercial, kitchen sink
    - a. Overall Dimensions: 36"x18".
    - b. Compartments:
      - 1) Dimensions: 14"x10.3"x10.3".
      - 2) Drain: Elkay LK35
        - a) Stainless steel body and removable conical basket strainer
        - b) Metal stem
        - c) Rubber stopper

- d) Location: Centered in compartment.
- c. Faucet(s): Required.
  - 1) Number Required: One.
  - 2) Mounting: Deck, back ledge.
- d. Construction: Seamless die-drawn, 18 gauge type 304 stainless steel. Self-rimming top with stainless steel mounting channels. Fully coated underside for sound deadening and condensation reduction.
- e. Supplies: NPS 1/2 chrome-plated copper with loose key angle stops.
- f. Drain Location: Off-centered rear right drain connection
- g. Drain Piping: NPS 1 1/2 chrome-plated, cast-brass P-trap with cleanout plug; 0.045-inch- thick tubular brass waste to wall; and wall escutcheon(s).
- h. Standard: NSF.

### 2.15 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
  - 1. NPS 1/2 (DN 15)
  - 2. ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

#### 2.16 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 (DN 40) offset and straight tailpiece.
- C. Trap:
  - 1. Size: NPS 1-1/2 (DN 40).
  - 2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-(0.83-mm-) thick brass tube to wall; and chrome-plated brass or steel wall flange.

PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install all fixtures, material, accessories, etc. according to the manufacturer's instructions.

## 3.2 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.3 WATER CLOSET INSTALLATION

- A. Water-Closet Installation:
  - 1. Install level and plumb according to roughing-in drawings.
  - 2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
  - 3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
- B. Support Installation:
  - 1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
  - 2. Use carrier supports with waste-fitting assembly and seal.
  - 3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
- C. Flushometer-Valve Installation:
  - 1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
  - 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
  - 3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
  - 4. Install actuators in locations that are easy for people with disabilities to reach.
- D. Install toilet seats on water closets.
- E. Wall Flange and Escutcheon Installation:

- 1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
- 2. Install deep-pattern escutcheons if required to conceal protruding fittings.
- F. Joint Sealing:
  - 1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
  - 2. Match sealant color to water-closet color.

## 3.4 URINAL INSTALLATION

- A. Urinal Installation:
  - 1. Install urinals level and plumb according to roughing-in drawings.
  - 2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
  - 3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
  - 4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
  - 5. Install trap-seal liquid in waterless urinals.
- B. Support Installation:
  - 1. Install supports, affixed to building substrate, for wall-hung urinals.
  - 2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
  - 3. Use carriers without waste fitting for urinals with tubular waste piping.
  - 4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
- C. Flushometer-Valve Installation:
  - 1. Install flushometer-valve water-supply fitting on each supply to each urinal.
  - 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
  - 3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
  - 4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- D. Wall Flange and Escutcheon Installation:
  - 1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
  - 2. Install deep-pattern escutcheons if required to conceal protruding fittings.
- E. Joint Sealing:
  - 1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
  - 2. Match sealant color to urinal color.

## 3.5 LAVATORY INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.
- E. Seal joints between lavatories and counters and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- G. Connect DC powered faucets to transformer.

## 3.6 SINK INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
  - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink.
  - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

# 3.7 GENERAL INSTALLATION

#### PLUMBING FIXTURES

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install floor mounted concealed arm supports, affixed to building substrate, for wall-mounting fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install counter-mounting fixtures in and attached to casework.
- D. Install fixtures level and plumb according to roughing-in drawings.
- E. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture.
- F. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- G. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- H. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- I. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- J. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- K. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- L. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.
- M. Install brass flanges on flushometers spud connections.
- N. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

# 3.8 CONNECTIONS

## PLUMBING FIXTURES

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste and vent piping. Use size fittings required to match fixtures.
- C. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

## 3.9 FIELD QUALITY CONTROL

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- D. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- E. Check that plumbing fixtures are complete with trim, faucets, fittings and other specified components.
- F. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- G. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

## 3.10 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Install fresh batteries in sensor-operated mechanisms.

## 3.11 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

# 3.12 **PROTECTION**

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

# END OF SECTION 224000

SECTION 224713 - DRINKING FOUNTAINS

## 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 drinking fountains and related components.
- B. Related Sections:
  - 1. Section 221116 "Domestic Water Piping".
  - 2. Section 221316 "Sanitary Waste and Vent Piping".

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountain.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include operating characteristics, and furnished specialties and accessories.
- B. LEED Submittals:
  - 1. Product Data for Prerequisite WE 1, Credit WE 2, and Credit WE 3: Documentation indicating flow and water consumption requirements.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to include in maintenance manuals.

# PART 2 - PRODUCTS

# 2.1 DRINKING FOUNTAINS

- A. Drinking Fountains DF-1: Bi-level Stainless steel, wall mounted.
  - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
- a. <u>Filtrine Manufacturing Company</u>.
- b. <u>Halsey Taylor</u>.
- c. <u>Haws Corporation</u>.
- d. <u>Elkay Manufacturing Co</u>.
- 2. Standards:
  - a. Comply with ADA, ASME A112.19.3/CSA B45.4.
  - b. Comply with NSF 61 and the Safe Drinking Water Act.
  - c. Comply with ANSI 117:1.
- 3. Type Receptor: With back.
- 4. Receptor Shape: Rectangular, bi-level.
- 5. Back Panel: Stainless-steel wall plate behind drinking fountain.
- 6. Bubblers: One, with adjustable stream regulator, located on deck.
- 7. Control: Push button, on the front.
- 8. Drain: Grid type with NPS 1-1/4 (DN 32) tailpiece.
- 9. Supply: NPS 3/8 (DN 10) with shutoff valve.
- 10. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) chrome-plated brass P-trap and waste.
- 11. Support: ASME A112.6.1M, Type III lavatory carrier.
- 12. Strainer: In-line, traps 140 micron particles.

# PART 3 - EXECUTION

# 3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

# 3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

# 3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

#### 3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

# 3.5 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

# SECTION 224716 - PRESSURE WATER COOLERS

### 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 pressure water coolers and related components.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 2 of each.

# PART 2 - PRODUCTS

# 2.1 PRESSURE WATER COOLERS

A. Pressure Water Coolers (EWC-1): Flush mounted, wheelchair accessible.

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
  - a. <u>Elkay Manufacturing Co</u>.
  - b. <u>Halsey Taylor</u>.
  - c. <u>Haws Corporation</u>.
- 2. Cabinet: Bi-level with two attached bowls, all stainless steel.
- 3. Bubbler: One, with adjustable stream regulator, located on each bowl.
- 4. Control: Push button.
- 5. Drain: Grid with NPS 1-1/4 tailpiece.
- 6. Supply: NPS 3/8 with shutoff valve.
- 7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
- 8. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
- 9. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
  - 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.
- 10. Capacities and Characteristics:
  - a. Cooled Water: 8 gph.
  - b. Ambient-Air Temperature: 90 deg F.
  - c. Inlet-Water Temperature: 80 deg F.
  - d. Cooled-Water Temperature: 50 deg F.
  - e. Lead free design in accordance with NSF/ANSI 61 and 372
  - f. Bottle Filler:
    - 1) Touchless activation with 20 second auto shutoff.
    - 2) Fill rate: 1.1 gpm.
    - 3) Drain to water cooler drain system.
  - g. Electrical Characteristics:
    - 1) Full Load Amperage: 5.0.
    - 2) Volts: 120-V ac.
    - 3) Phase: Single.
    - 4) Hertz: 60.
- 11. Support: Manufacturer's standard for in wall mounting.
- 12. Water Cooler Mounting Height: Handicapped/elderly according to ICC A117.1
- B. Pressure Water Coolers (EWC-2): Wall mounted, standard.
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:

# ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON

- a. <u>Elkay Manufacturing Co</u>.
- b. <u>Halsey Taylor</u>.
- c. <u>Haws Corporation</u>.
- 2. Cabinet: Single bowl, all stainless steel.
- 3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
- 4. Control: Push button.
- 5. Drain: Grid with NPS 1-1/4 tailpiece.
- 6. Supply: NPS 3/8 with shutoff valve.
- 7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
- 8. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
- 9. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
  - 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.
- 10. Capacities and Characteristics:
  - a. Cooled Water: 8 gph.
  - b. Ambient-Air Temperature: 90 deg F.
  - c. Inlet-Water Temperature: 80 deg F.
  - d. Cooled-Water Temperature: 50 deg F.
  - e. Lead free design in accordance with NSF/ANSI 61 and 372
  - f. Bottle Filler:
    - 1) Touchless activation with 20 second auto shutoff.
    - 2) Fill rate: 1.1 gpm.
    - 3) Drain to water cooler drain system.
  - g. Electrical Characteristics:
    - 1) Full Load Amperage: 5.0.
    - 2) Volts: 120-V ac.
    - 3) Phase: Single.
  - h. Hertz: 60.
- 11. Water Cooler Mounting Height: Standard.

# PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

# 3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

# 3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball or gate shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

# 3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

### 3.5 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

# 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 the following:
  - 1. General requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
  - 2. Enclosed controllers rated 600 V and less:
    - a. Full-voltage manual.
    - b. Reduced voltage magnetic

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.

### 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

### 1.5 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.

### 1.6 SUBMITTALS

- A. Product Data: For each type of enclosed controller.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
- D. Field quality-control reports.
- E. Operation and maintenance data.

#### 1.7 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.
- B. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

### 1.8 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. Comply with NFPA 70.

1.9 IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems".

# PART 2 - PRODUCTS

### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

- 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

# 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

# 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

### 2.6 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  - 2. Configuration: Non-reversing.
  - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
  - 4. Surface mounting.
  - 5. Green pilot light.

### 2.7 REDUCED-VOLTAGE MAGNETIC CONTROLLERS

- A. General Requirements for Reduced-Voltage Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A; closed-transition; adjustable time delay on transition.
- B. Combination Reduced-Voltage Magnetic Controller: Factory-assembled combination of reduced-voltage, electrically held magnetic controller and disconnecting means.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  - 2. Configuration:
    - a. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
  - 3. Contactor Coils: Pressure-encapsulated type.

- a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
- 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
- 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
  - a. CPT Spare Capacity: 200 VA.
- 6. Bimetallic Overload Relays:
  - a. Inverse-time-current characteristic.
  - b. Class 20 tripping characteristic.
  - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  - d. Ambient compensated.
  - e. Automatic resetting.
- 7. External overload reset push button.
- 8. Non-fusible Disconnecting Means:
  - a. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
  - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

# 2.8 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
  - 1. Dry and Clean Indoor Locations: Type 1.
  - 2. Outdoor Locations: Type 3R.
  - 3. Kitchen or Wash-Down Areas: Type 4X.
  - 4. Other Wet or Damp Indoor Locations: Type 4.
  - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

# 2.9 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  - 1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty.
    - a. Push Buttons: Unguarded types; maintained or momentary as indicated.
    - b. Pilot Lights: LED types; colors as indicated.

- B. Reversible N.C./N.O. auxiliary contact(s).
- C. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4, Type 4X, and Type 7 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- D. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 3R and Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- E. Spare control wiring terminal blocks, quantity as indicated; wired.

# PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Seismic Bracing: Comply with requirements specified in Division 26 Section "Seismic Controls for Electrical Systems."
- C. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- D. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- F. Comply with NECA 1.

#### 3.2 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 23 Section " Identification for HVAC Piping and Equipment."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved nameplate.
- B. Label each enclosure-mounted control and pilot device.

### 3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Division 26.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
- D. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

# 3.4 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers at 80 percent.

# 3.5 **PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

# 3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

# SECTION 230516 - EXPANSION FITTINGS AND LOOPS 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. Flexible-hose packless expansion joints.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Welding certificates.
- D. Product Certificates: For each type of expansion joint, from manufacturer.
- E. Maintenance Data: For expansion joints to include in maintenance manuals.

# 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
  - 2. ASME Boiler and Pressure Vessel Code: Section IX.
  - 3. Washington Association of Building Officials

### PART 2 - PRODUCTS

#### 2.1 PACKLESS EXPANSION JOINTS

- A. Flexible-Hose Packless Expansion Joints:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flexicraft Industries.
    - b. Flex Pression Ltd.
    - c. Metraflex, Inc.
    - d. Unisource Manufacturing, Inc.
  - 2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
  - 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
  - 4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
    - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
  - 5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
  - 6. Expansion Joints for Steel Piping NPS 2 and Smaller: Stainless-steel fittings with threaded end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
  - 7. Expansion Joints for Cast Iron and Steel Piping NPS 2-1/2 to NPS 6: Stainless-steel fittings with flanged end connections.

- a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
- b. Clean out tee where used in waste system.

# PART 3 - EXECUTION

### 3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

# SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION 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. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.

#### 1.3 ACTION SUBMITTALS

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

#### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

# 2.2 STACK-SLEEVE FITTINGS

A. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

### 2.3 SLEEVE-SEAL SYSTEMS

- A. 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: Stainless steel.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

### 2.4 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

### 2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

#### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. 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.
- C. 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.
- D. Install sleeves for pipes passing through interior 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."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

# 3.3 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.

# 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

# 3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 10: Galvanized-steel wall sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 10: Galvanized-steel-pipe 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) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 10: Galvanized-steel-pipe 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) 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 10: Sleeve-seal fittings.
    - b.

- 5. Interior Partitions:
  - a. Piping Smaller Than NPS 10: Galvanized-steel-pipe sleeves.

# SECTION 230518 - ESCUTCHEONS FOR FIRE-SUPPRESSION 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.

### 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 and rough-brass 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.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

# ESCUTCHEONS FOR HVAC PIPING

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 or split-casting brass type with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, castbrass or split-casting brass type with polished, chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting 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 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, chromeplated 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.

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# 3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

# 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.
  - 6. Test-plug kits.
  - 7. Sight flow indicators.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

# 1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

# 1.5 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, provide products by one of the following:

# METERS AND GAGES FOR HVAC PIPING

- a. Trerice, H. O. Co.
- b. Weiss Instruments, Inc.
- c. WIKA Instrument Corporation.
- 2. Case: Metal; 9-inch nominal size unless otherwise indicated.
- 3. Scale(s): Deg F and deg C.
- 4. Case Form: Adjustable angle.
- 5. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
- 6. Stem: Aluminum and of length to suit installation.
  - a. Design for Thermowell Installation: Bare stem.
- 7. Display: Digital.
- 8. Accuracy: Plus or minus 2 deg F.
- B. Remote-Mounted, Light-Activated Thermometers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Miljoco Corporation.
    - b. Weiss Instruments, Inc.
  - 2. Case: Plastic, for wall mounting.
  - 3. Scale(s): Deg F and deg C.
  - 4. Sensor: Bulb and thermister wire.
    - a. Design for Thermowell Installation: Bare stem.
  - 5. Display: Digital.
  - 6. Accuracy: Plus or minus 2 deg F.

# 2.2 THERMOWELLS

- A. Thermowells:
  - 1. Standard: ASME B40.200.
  - 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: CRES.
  - 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, provide products by one of the following:
    - a. Ametek U.S. Gauge.
    - b. Ashcroft Inc.
    - c. Miljoco Corporation.
    - d. Trerice, H. O. Co.
    - e. Watts; a Watts Water Technologies company.
    - f. Weiss Instruments, Inc.
  - 2. Standard: ASME B40.100.
  - 3. Case: Liquid-filled 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 or NPS 1/2, 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.
  - 8. Pointer: Dark-colored metal.
  - 9. Window: Glass or plastic.
  - 10. Ring: Brass.
  - 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.
- B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ametek U.S. Gauge.
    - b. Ashcroft Inc.
    - c. Miljoco Corporation.
    - d. Trerice, H. O. Co.
    - e. Watts; a Watts Water Technologies company.
    - f. Weiss Instruments, Inc.
  - 2. Standard: ASME B40.100.
  - 3. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter with front flange and holes for panel mounting.
  - 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

- 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, 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.
- 8. Pointer: Dark-colored metal.
- 9. Window: Glass or plastic.
- 10. Ring: Metal.
- 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

# 2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, 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 or NPS 1/2, ASME B1.20.1 pipe threads.

# 2.5 TEST PLUGS

- A. Description: Test-station fitting made for insertion into piping tee fitting.
- B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- C. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- E. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

# 2.6 TEST-PLUG KITS

- A. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- B. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- C. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- D. Carrying Case: Metal or plastic, with formed instrument padding.

# 2.7 SIGHT FLOW INDICATORS

A. Description: Piping inline-installation device for visual verification of flow.

- B. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- C. Minimum Pressure Rating: 150 psig.
- D. Minimum Temperature Rating: 200 deg F.
- E. End Connections for NPS 2 and Smaller: Threaded.
- F. End Connections for NPS 2-1/2 and Larger: Flanged.

# PART 3 - EXECUTION

# 3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid 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 remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
  - 1. Outside-, return-, supply-, and mixed-air ducts.
  - 2. Inlet and outlet of each hydronic zone.
  - 3. Inlet and outlet of each hydronic coil in air-handling units.
- L. Install pressure gages in the following locations:
  - 1. Suction and discharge of each pump.

### 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 heater shall be the following:
  - 1. Direct Remote-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 Heating Hot Hot-Water Piping: 30 to 240 deg F.

# 3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages shall be the following:
  - 1. Liquid-filled, direct-mounted, metal case.
  - 2. Test plug with EPDM self-sealing rubber inserts.

# SECTION 230523.12 - BALL VALVES FOR HVAC PIPING

# PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Brass ball valves.
  - 2. Bronze ball valves.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

### 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 B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 3. ASME B16.18 for solder-joint connections.
  - 4. ASME B31.1 for power piping valves.
  - 5. ASME B31.9 for building services piping 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 4.
- 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 BRASS BALL VALVES

- A. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Milwaukee Valve Company.
  - 2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: 150 psig.
    - c. CWP Rating: 600 psig.
    - d. Body Design: Two piece.
    - e. Body Material: Forged brass.
    - f. Ends: Threaded.
    - g. Seats: PTFE.
    - h. Stem: Stainless steel.
    - i. Ball: Stainless steel, vented.
    - j. Port: Full.

### 2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Milwaukee Valve Company.
  - 2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: 150 psig.
    - c. CWP Rating: 600 psig.
    - d. Body Design: Two piece.

- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

# PART 3 - EXECUTION

### 3.1 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.

### 3.2 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 valveend option is indicated in valve schedules below.
  - 2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

### 3.3 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Brass or bronze ball valves, two piece, with stainless-steel trim, and full regular reduced port.
  - 1. Valves may be provided with solder-joint ends instead of threaded ends.

# END OF SECTION 230523.12

# SECTION 230523.13 - BUTTERFLY VALVES FOR HVAC PIPING

# PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Iron, single-flange butterfly valves.
  - 2. High-performance butterfly valves.
  - 3. Chainwheels.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

# 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 B16.1 for flanges on iron valves.
  - 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 3. ASME B31.1 for power piping valves.
  - 4. ASME B31.9 for building services piping valves.
- C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream piping unless otherwise indicated.
- E. Valve Actuator Types:
  - 1. Gear Actuator: For valves NPS 8 and larger.
  - 2. Handlever: For valves NPS 6 and smaller.
  - 3. Chainwheel: Device for attachment to gear, stem, or other actuator of size and with chain for mounting height, according to "Valve Installation" Article.
- F. Valves in Insulated Piping: With 2-inch stem extensions with extended necks.
#### 2.2 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Milwaukee Valve Company</u>.
    - b. <u>NIBCO INC</u>.
    - c. <u>Red-White Valve Corporation</u>.
  - 2. Description:
    - a. Standard: MSS SP-67, Type I.
    - b. CWP Rating: 150 psig.
    - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
    - e. Seat: EPDM.
    - f. Stem: One- or two-piece stainless steel.
    - g. Disc: Stainless steel.

## 2.3 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to hand wheels.
  - 1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
  - 2. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

#### PART 3 - EXECUTION

#### 3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

# 3.2 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.

# 3.3 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2-1/2 and Larger:
  - 1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: Stainless-steel disc, 200 CWP, and EPDM seat.

END OF SECTION 230523.13

## SECTION 230523.14 - CHECK VALVES FOR HVAC PIPING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

# A.

B. 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, center-guided check valves.

## 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. SWP: Steam 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, 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 B31.1 for power piping valves.
  - 6. 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. Bronze Swing Check Valves with Bronze Disc, Class 125:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Milwaukee Valve Company.
    - b. Red-White Valve Corporation.
    - c. Stockham; Crane Energy Flow Solutions.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 3.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.

- e. Ends: Threaded.
- f. Disc: Bronze.

# 2.3 IRON, CENTER-GUIDED CHECK VALVES

- A. Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat, Class 125:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hammond Valve.
    - b. Milwaukee Valve Company.
    - c. Mueller Steam Specialty.
  - 2. Description:
    - a. Standard: MSS SP-125.
    - 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 and Plate-Type 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 valveend 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 Copper Tubing, NPS 5 and Larger: Flanged ends.
  - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
  - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
  - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

## 3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

## CHECK VALVES FOR HVAC PIPING

- 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
- 2. Bronze swing check valves with bronze disc, Class 125.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Iron, compact-wafer, center-guided check valves with metal seat, Class 125.

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 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.
  - 2. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
  - 3. Section 233113 "Metal 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. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

- 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- 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. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Pipe stands.
  - 4. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers.
  - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

## 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.
- 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

#### 2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

#### 2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>Allied Tube & Conduit; a part of Atkore International</u>.
    - b. <u>B-line, an Eaton business</u>.
    - c. <u>Flex-Strut Inc</u>.
    - d. Thomas & Betts Corporation; A Member of the ABB Group.
    - e. <u>Unistrut; Part of Atkore International</u>.
  - 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
  - 3. Standard: MFMA-4.
  - 4. Channels: Continuous slotted steel channel with inturned lips.
  - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  - 7. Metallic Coating: Hot-dipped galvanized.

#### 2.4 THERMAL-HANGER SHIELD INSERTS

- A. <u>Manufacturers:</u> 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. <u>National Pipe Hanger Corporation</u>.

- 2. <u>Pipe Shields Inc</u>.
- 3. <u>Rilco Manufacturing Co., Inc.</u>
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-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 minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, [**zinc-coated**] [**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. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
  - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 2. Base: Plastic.
  - 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 plastic or stainlesssteel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:

- 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
- 2. Bases: One or more; plastic.
- 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.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structuralsteel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

# 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 carbonsteel 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.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 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. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 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.
- F. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. 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.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- N. 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.
- O. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weightdistribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weightdistribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

# 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

#### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 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.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

## 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow offcenter closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steelpipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  - 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

- 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
- 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
- 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  - 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. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  - 5. 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. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  - 6. C-Clamps (MSS Type 23): For structural shapes.
  - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel Ibeams for heavy loads.

- 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel Ibeams for heavy loads, with link extensions.
- 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
- 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
  - a. Light (MSS Type 31): 750 lb.
  - b. Medium (MSS Type 32): 1500 lb.
  - c. Heavy (MSS Type 33): 3000 lb.
- 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.

- c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 230529

ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS 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. Elastomeric isolation pads.
  - 2. Elastomeric isolation mounts.
  - 3. Restrained elastomeric isolation mounts.
  - 4. Open-spring isolators.
  - 5. Housed-spring isolators.
  - 6. Restrained-spring isolators.
  - 7. Housed-restrained-spring isolators.
  - 8. Pipe-riser resilient supports.
  - 9. Resilient pipe guides.
  - 10. Elastomeric hangers.
  - 11. Spring hangers.
  - 12. Snubbers.
  - 13. Restraint channel bracings.
  - 14. Restraint cables.
  - 15. Seismic-restraint accessories.
  - 16. Mechanical anchor bolts.
  - 17. Adhesive anchor bolts.
- B. Related Requirements:
  - 1. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
  - 2. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.
- 1.3 DEFINITIONS
  - A. IBC: International Building Code.
  - B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

#### 1.4 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 and seismic-restraint component required.
    - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    - b. Annotate to indicate application of each product submitted and compliance with requirements.
  - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
  - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
  - 1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
  - 3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
  - 4. Seismic-Restraint Details:
    - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

# PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading: Reference Structural Contract Documents.
  - 1. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

# 2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>.
  - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 3. Size: Factory or field cut to match requirements of supported equipment.
  - 4. Pad Material: Oil and water resistant with elastomeric properties.
  - 5. Surface Pattern: Ribbed pattern.
  - 6. Infused nonwoven cotton or synthetic fibers.
  - 7. Load-bearing metal plates adhered to pads.

# 2.3 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>.
  - 2. Mounting Plates:
    - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
    - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
  - 3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

- A. Restrained Elastomeric Isolation Mounts:
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>.
  - 2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
    - a. Housing: Cast-ductile iron or welded steel.
    - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

# 2.5 OPEN-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>
  - 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. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
  - 7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

# 2.6 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:

- a. <u>California Dynamics Corporation</u>.
- b. <u>Kinetics Noise Control, Inc</u>.
- c. <u>Mason Industries, Inc</u>.
- d. <u>Vibration Isolation</u>
- 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. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
  - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Top housing with threaded mounting holes and internal leveling device.

# 2.7 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>
  - 2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
    - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Top plate with threaded mounting holes.
    - c. Internal leveling bolt that acts as blocking during installation.
  - 3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
  - 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: .

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- 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
  - a. <u>California Dynamics Corporation</u>.
  - b. <u>Kinetics Noise Control, Inc</u>.
  - c. <u>Mason Industries, Inc</u>.
  - d. <u>Vibration Isolation</u>
- 2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
  - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
- 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

# 2.9 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
  - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  - 2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

# 2.10 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
  - 2. 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.

3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

# 2.11 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .
  - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
    - a. <u>California Dynamics Corporation</u>.
    - b. <u>Kinetics Noise Control, Inc</u>.
    - c. <u>Mason Industries, Inc</u>.
    - d. <u>Vibration Isolation</u>.
  - 2. 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.
  - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  - 8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
  - 9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.12 SNUBBERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
  - 1. <u>Kinetics Noise Control, Inc</u>.
  - 2. <u>Mason Industries, Inc</u>.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
  - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
  - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

## 2.13 RESTRAINT CHANNEL BRACINGS

A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

## 2.14 RESTRAINT CABLES

A. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

# 2.15 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

# 2.16 MECHANICAL ANCHOR BOLTS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
  - 1. <u>B-line, an Eaton business</u>.
  - 2. <u>Hilti, Inc</u>.
  - 3. <u>Kinetics Noise Control, Inc</u>.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

#### 3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
  - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
  - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

- E. Piping Restraints:
  - 1. Comply with requirements in MSS SP-127.
  - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  - 3. Brace a change of direction longer than 12 feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- K. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

## 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

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## 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  - 5. Test to 90 percent of rated proof load of device.
  - 6. Measure isolator restraint clearance.
  - 7. Measure isolator deflection.
  - 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

# 3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 230548

## 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. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Stencils.
  - 5. Valve tags.
  - 6. Warning tags.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

#### PART 2 - PRODUCTS

- 2.1 EQUIPMENT LABELS
  - A. Metal Labels for Equipment:
    - 1. Material and Thickness: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
    - 2. Letter Color: Black.
    - 3. Background Color: White.

- 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-quarters the size of principal lettering.
- 6. Fasteners: Stainless-steel rivets or self-tapping screws.
- 7. 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 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. 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.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full 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; 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: Size letters according to ASME A13.1 for piping.

## 2.4 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.
- 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.

## 2.5 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Safety yellow background with black lettering.

## PART 3 - EXECUTION

#### 3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

#### 3.2 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- 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. Heating Water Piping: White letters on a safety-green background.
  - 2. Refrigerant Piping: White letters on a safety-purple background.

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## 3.5 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue: For cold-air supply ducts.
  - 2. Yellow: For hot-air supply ducts.
  - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feetin each space where ducts are exposed or concealed by removable ceiling system

## 3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Refrigerant: 1-1/2 inches, round.
    - b. Hot Water: 1-1/2 inches, round.
  - 2. Valve-Tag Colors:
    - a. Refrigerant: White letters on a safety-purple background.
    - b. Heating hot water: White letters on a safety-green background.

## 3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553
# SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  - 2. Balancing Hydronic Piping Systems:
    - a. Variable-flow hydronic systems.
    - b. Primary-secondary hydronic systems.
  - 3. Testing, Adjusting, and Balancing Equipment:
    - a. Motors.
  - 4. Testing, adjusting, and balancing existing systems and equipment.
  - 5. Sound tests.
  - 6. Vibration tests.
  - 7. Duct leakage tests.
  - 8. Control system verification.

## 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- 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. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. 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.
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 "Air Balancing."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 "System Balancing."

#### 1.6 FIELD CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- PART 2 PRODUCTS (Not Applicable)

#### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine 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 design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 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.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

## 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. 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. Variable-frequency controllers' startup is complete and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Ceilings are installed.
    - i. Windows and doors are installed.
    - j. 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. Variable-frequency controllers' startup is complete and safeties are verified.
- k. Suitable access to balancing devices and equipment is provided.

## 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" 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, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

## 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

# 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. 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. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  - 5. 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-performance data.

#### 3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Adjust the variable-air-volume systems as follows:
  - 1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
  - 2. Verify that the system is under static pressure control.
  - 3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  - 4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
    - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.

- c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
- d. Adjust controls so that terminal is calling for minimum airflow.
- e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
- f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
- g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
- 5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
  - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
  - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
  - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
  - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
- 6. 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 any artificial loading of filters at the time static pressures are measured.
- 7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
  - a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
  - b. Verify that terminal units are meeting design airflow under system maximum flow.
- 8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
- 9. Verify final system conditions as follows:
  - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.

- b. Re-measure and confirm that total airflow is within design.
- c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
- d. Mark final settings.
- e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
- f. Verify tracking between supply and return fans.

#### 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. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. 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.
- c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
- 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 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.
- 5. 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.
- 6. Prior to verifying final system conditions, determine the system differential-pressure set point.
- 7. 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.
- 8. Mark final settings and verify that all memory stops have been set.
- 9. 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.
- 10. Verify that memory stops have been set.
- D. For systems with diversity:
  - 1. Determine diversity factor.
  - 2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
  - 3. 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.
    - c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
  - 4. 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.
  - 5. 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.
- 6. 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.
- 7. 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.
- 8. 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.
- 9. Prior to verifying final system conditions, determine system differential-pressure set point.
- 10. 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.
- 11. Mark final settings and verify that memory stops have been set.
- 12. 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.
- 13. Verify that memory stops have been set.

## 3.9 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first.
- B. Balance the secondary circuits after the primary circuits are complete.
- C. Adjust pumps to deliver total design gpm.
  - 1. Measure total water flow.
    - a. Position valves for full flow through coils.
    - b. Measure flow by main flow meter, if installed.
    - c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
  - 2. Measure pump TDH as follows:

- a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
- b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
- c. Convert pressure to head and correct for differences in gage heights.
- d. 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.
- e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
- 3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
- D. Adjust flow-measuring devices installed in mains and branches to design water flows.
  - 1. Measure flow in main and branch pipes.
  - 2. Adjust main and branch balance valves for design flow.
  - 3. Re-measure each main and branch after all have been adjusted.
- E. Adjust flow-measuring devices installed at terminals for each space to design water flows.
  - 1. Measure flow at terminals.
  - 2. Adjust each terminal to design flow.
  - 3. Re-measure each terminal after it is adjusted.
  - 4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
  - 5. Perform temperature tests after flows have been balanced.
- F. For systems with pressure-independent valves at terminals:
  - 1. Measure differential pressure and verify that it is within manufacturer's specified range.
  - 2. Perform temperature tests after flows have been verified.
- G. For systems without pressure-independent valves or flow-measuring devices at terminals:
  - 1. Measure and balance coils by either coil pressure drop or temperature method.
  - 2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
- H. Verify final system conditions as follows:
  - 1. Re-measure and confirm that total water flow is within design.
  - 2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
  - 3. Mark final settings.
- I. Verify that memory stops have been set.

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#### 3.10 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer's name, model number, and serial number.
  - 2. Motor horsepower rating.
  - 3. Motor rpm.
  - 4. 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.

## 3.11 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.
- B. Measure, adjust, and record the following data for each electric heating coil:
  - 1. Nameplate data.
  - 2. Airflow.
  - 3. Entering- and leaving-air temperature at full load.
  - 4. Voltage and amperage input of each phase at full load.
  - 5. Calculated kilowatt at full load.
  - 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each refrigerant coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Wet-bulb temperature of entering and leaving air.
  - 3. Airflow.

#### 3.12 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at 5 locations as designated by the Architect.

#### B. Instrumentation:

- 1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
- 2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
- 3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
- 4. The accuracy of the sound-testing meter shall be plus or minus one decibel.
- C. Test Procedures:
  - 1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
  - 2. Equipment should be operating at design values.
  - 3. Calibrate the sound-testing meter prior to taking measurements.
  - 4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
  - 5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
  - 6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
  - 7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
  - 8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.
- D. Reporting:
  - 1. Report shall record the following:
    - a. Location.
    - b. System tested.
    - c. dBA reading.
    - d. Sound pressure level in each octave band with equipment on and off.
  - 2. Plot sound pressure levels on NC worksheet with equipment on and off.

#### 3.13 DUCT LEAKAGE TESTS

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.

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## 3.14 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.

# 3.15 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 refrigerant charge.
  - 4. Check the condition of filters.
  - 5. Check the condition of coils.
  - 6. Check the operation of the drain pan and condensate-drain trap.
  - 7. Check bearings and other lubricated parts for proper lubrication.
  - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- 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.

# 3.16 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 or minus 10 percent.
  - 2. Air Outlets and Inlets: Plus or minus 10 percent.
  - 3. Heating-Water Flow Rate: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

## 3.17 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

## 3.18 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.
  - 8. Report date.
  - 9. Signature of TAB supervisor who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  - 12. Nomenclature sheets for each item of equipment.
  - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
  - 15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. 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.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
  - 1. Quantities of outdoor, supply, return, and exhaust airflows.
  - 2. Water flow rates.
  - 3. Duct, outlet, and inlet sizes.
  - 4. Pipe and valve sizes and locations.
  - 5. Terminal units.
  - 6. Balancing stations.

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- 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
  - 1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, 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:
    - 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.
  - 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.
    - 1. Return-air damper position.
    - m. Vortex damper position.
- F. 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.
  - 1. Refrigerant expansion valve and refrigerant types.
  - m. Refrigerant suction pressure in psig.
  - n. Refrigerant suction temperature in deg F.
- G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
  - 1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
    - g. Sheave make, size in inches, 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.
- H. 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.
- I. Air-Terminal-Device Reports:
  - 1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Apparatus used for test.
    - d. Area served.
    - e. Make.
    - f. Number from system diagram.
    - g. Type and model number.
    - h. Size.
    - i. Effective area in sq. ft..
  - 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.
- J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
  - 1. Unit Data:

- a. System and air-handling-unit identification.
- b. Location and zone.
- c. Room or riser served.
- d. Coil make and size.
- e. Flowmeter type.
- 2. Test Data (Indicated and Actual Values):
  - a. Airflow rate in cfm.
  - b. Entering-water temperature in deg F.
  - c. Leaving-water temperature in deg F.
  - d. Water pressure drop in feet of head or psig.
  - e. Entering-air temperature in deg F.
  - f. Leaving-air temperature in deg F.
- K. 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.
    - 1. 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.

- L. Instrument Calibration Reports:
  - 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

#### 3.19 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect or commissioning authority.
- B. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
  - 3. If the second verification also fails, Architect may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

#### 3.20 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

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END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
  - 6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
  - 7. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 8. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 9. Outdoor, concealed supply and return.
  - 10. Outdoor, exposed supply and return.

## 1.2 ACTION SUBMITTALS

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

## 1.3 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.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

# PART 2 - PRODUCTS

# 2.1 INSULATION MATERIALS

- A. Comply with requirements in the insulation schedule on the plans 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. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290..
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>CertainTeed Corp.; SoftTouch Duct Wrap</u>.
    - b. Johns Manville; Microlite.
    - c. <u>Knauf Insulation; Friendly Feel Duct Wrap</u>.
    - d. Owens Corning; SOFTR All-Service Duct Wrap.
- E. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>CertainTeed Corp.; Commercial Board</u>.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. <u>Knauf Insulation; Insulation Board</u>.
    - e. <u>Manson Insulation Inc.; AK Board</u>.
    - f. <u>Owens Corning; Fiberglas 700 Series</u>.

## 2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>CertainTeed Corp.; FlameChek</u>.
    - b. Johns Manville; Firetemp Wrap.
    - c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
    - d. <u>Thermal Ceramics; FireMaster Duct Wrap</u>.
    - e. <u>3M; Fire Barrier Wrap Products</u>.
    - f. <u>Unifrax Corporation; FyreWrap</u>.

## 2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

- B. Mineral-Fiber Adhesive:
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; CP-127</u>.
    - b. <u>Eagle Bridges Marathon Industries; 225</u>.
    - c. <u>Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; 85-60/85-70</u>.
    - 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).
  - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Adhesive, and FSK Jacket Adhesive:
  - 1. <u>Products</u>: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; CP-82</u>.
    - b. Eagle Bridges Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60.
    - d. Mon-Eco Industries, Inc.; 22-25.
  - 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).
  - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 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. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers CP-38
- b. <u>Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; 30-80/30-90</u>.
- c. <u>Vimasco Corporation; 749</u>.
- 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
- 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
- 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; CP-10</u>.
    - b. Eagle Bridges Marathon Industries; 550.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    - d. Mon-Eco Industries, Inc.; 55-50.
    - e. <u>Vimasco Corporation; WC-1/WC-5</u>.
  - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  - 4. Solids Content: 60 percent by volume and 66 percent by weight.
  - 5. Color: White.

## 2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; CP-76</u>.
    - b. <u>Eagle Bridges Marathon Industries; 405</u>.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    - d. <u>Mon-Eco Industries, Inc.; 44-05</u>.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
  - 5. Color: Aluminum.

- 6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. ASJ Flashing Sealants, and Vinyl Jacket Flashing Sealants:
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; CP-76</u>.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
  - 5. Color: White.
  - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
  - 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
  - 5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

#### 2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. <u>Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; Mast-A-Fab</u>.
- b. <u>Vimasco Corporation; Elastafab 894</u>.

# 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Johns Manville; Zeston.
    - b. <u>P.I.C. Plastics, Inc.; FG Series</u>.
    - c. <u>Proto Corporation; LoSmoke</u>.
    - d. <u>Speedline Corporation; SmokeSafe</u>.
  - 2. Adhesive: As recommended by jacket material manufacturer.
- C. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - 1. Sheet and roll stock ready for shop or field sizing.
  - 2. Aluminum, Stucco Embossed: 0.024 inch (0.61 mm) thick.
  - 3. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
- D. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with aluminum-foil facing.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Polyguard Products, Inc.; Alumaguard 60</u>.

## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>ABI, Ideal Tape Division; 428 AWF ASJ</u>.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.

- c. <u>Compac Corporation; 104 and 105</u>.
- d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
- 2. Width: 3 inches (75 mm).
- 3. Thickness: 11.5 mils (0.29 mm).
- 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
- 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>ABI, Ideal Tape Division; 491 AWF FSK</u>.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. <u>Compac Corporation; 110 and 111</u>.
    - d. <u>Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ</u>.
  - 2. Width: 3 inches (75 mm).
  - 3. Thickness: 6.5 mils (0.16 mm).
  - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>ABI, Ideal Tape Division; 370 White PVC tape</u>.
    - b. <u>Compac Corporation; 130.</u>
    - c. <u>Venture Tape; 1506 CW NS</u>.
  - 2. Width: 2 inches (50 mm).
  - 3. Thickness: 6 mils (0.15 mm).
  - 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
  - 5. Elongation: 500 percent.
  - 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>ABI, Ideal Tape Division; 488 AWF</u>.

- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
- c. <u>Compac Corporation; 120</u>.
- d. <u>Venture Tape; 3520 CW</u>.
- 2. Width: 2 inches (50 mm).
- 3. Thickness: 3.7 mils (0.093 mm).
- 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
- 5. Elongation: 5 percent.
- 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

## 2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide.
  - 1. <u>Products</u>: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>ITW Insulation Systems; Gerrard Strapping and Seals</u>.
    - b. <u>RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs</u>.
- B. Insulation Pins and Hangers:
  - 1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. <u>Products</u>: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      - 2) <u>GEMCO; Perforated Base</u>.
      - 3) <u>Midwest Fasteners, Inc.; Spindle</u>.
    - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
    - c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  - 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

- a. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - 1) <u>GEMCO; Nylon Hangers</u>.
  - 2) <u>Midwest Fasteners, Inc.; Nylon Insulation Hangers</u>.
- b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
- c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
- d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
    - 2) <u>GEMCO; Peel & Press</u>.
    - 3) <u>Midwest Fasteners, Inc.; Self Stick</u>.
  - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
  - c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.
- 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
  - a. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) <u>AGM Industries, Inc.; RC-150</u>.
    - 2) <u>GEMCO; R-150</u>.
    - 3) <u>Midwest Fasteners, Inc.; WA-150</u>.
    - 4) <u>Nelson Stud Welding; Speed Clips</u>.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-(0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

- a. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
  - 1) <u>GEMCO</u>.
  - 2) <u>Midwest Fasteners, Inc</u>.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy, 0.062-inch (1.6-mm) soft-annealed, stainless steel, or 0.062-inch (1.6-mm) soft-annealed, galvanized steel.
  - 1. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
    - a. <u>C & F Wire</u>.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

## 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of 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. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, 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 duct flanges and fittings.
- 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 (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

# 3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

- 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
- 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
  - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
  - 1. Comply with requirements in other sections for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
  - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
  - 2. Seal penetrations through fire-rated assemblies.

## 3.4 PRE-INSULATED DUCTWORK

A. Pre-insulated ductwork (internal or external insulation as shown on the schedule on the plans) may be used. Insulations shall meet the R-value shown on the schedule on the plans.

## 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, capacitordischarge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
  - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - 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 (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vaporbarrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
- 5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) 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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

- 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
- 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitordischarge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
  - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vaporbarrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
- 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

# 3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.

- 3. Secure jacket to insulation with manufacturer's recommended adhesive.
- 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
- 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.
- C. Exterior Exposed Insulation: Where indicated, install specified continuous self-adhesive outdoor jacket per manufacturer's instructions and seal all joints and seams waterproof. In temperatures below 50° F use manufacturer's cold weather activator to insure adhesion.

### 3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies.

#### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.
- 3.9 DUCT INSULATION SCHEDULE: Refer to the plans for insulation schedules.

# END OF SECTION 230713

# SECTION 230716 - HVAC EQUIPMENT INSULATION

# PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section includes insulating the following HVAC equipment that is not factory insulated:
  - 1. Heating, hot-water pumps.
- B. Related Sections:
  - 1. Section 230713 "Duct Insulation."
  - 2. Section 230719 "HVAC Piping 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).
- B. Sustainable Design Submittals:
  - 1. Product Data: For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
  - 3. Product Data: For coatings, indicating VOC content.
  - 4. Laboratory Test Reports: For coatings, indicating compliance with requirements for lowemitting materials.
  - 5. Product Data: For sealants, indicating VOC content.
  - 6. Laboratory Test Reports: For sealants, indicating compliance with requirements for lowemitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail removable insulation at equipment connections.
  - 4. Detail application of field-applied jackets.
  - 5. Detail application at linkages of control devices.
  - 6. Detail field application for each equipment type.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

### 1.5 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.

#### 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 equipment Installer for equipment insulation application.
- C. Coordinate installation and testing of heat tracing.

#### 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 "Breeching Insulation Schedule" and "Equipment 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. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation without factory-applied jacket. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Section 016000 "Product Requirements."
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.

# 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

#### 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Fiberglass 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. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of

Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

### 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. VOC Content: 300 g/L or less.
  - 2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: 60 percent by volume and 66 percent by weight.
  - 4. Color: White.

#### 2.5 SEALANTS

- A. Joint Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Permanently flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 100 to plus 300 deg F.
  - 4. Color: White or gray.
  - 5. Sealant shall have a VOC content of 420 g/L or less.
  - 6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

# 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 and equipment 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 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.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- 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 equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment 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.
  - 4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- 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.
- N. For above ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

# 3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
- B. Insulation Installation on Pumps:

- 1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
- 2. Fabricate boxes from galvanized steel, at least 0.050 inch thick.
- 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

# 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

# 3.6 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment that is not factory insulated.
- C. Heating-hot-water pump insulation shall be the following:
  1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

# END OF SECTION 230716

SECTION 230719 - HVAC PIPING INSULATION

# PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
  - 1. Refrigerant suction and hot-gas piping.

# 1.2 ACTION SUBMITTALS

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

### 1.3 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.

# PART 2 - PRODUCTS

# 2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products located in return air plenums shall be noncombustible with 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.
- 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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

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- E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Pittsburgh Corning Corporation;</u> Foamglas.
  - 2. Block Insulation: ASTM C 552, Type I.
  - 3. Special-Shaped Insulation: ASTM C 552, Type III.
  - 4. Board Insulation: ASTM C 552, Type IV.
  - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  - 6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
  - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Aeroflex USA, Inc.; Aerocel</u>.
    - b. <u>Armacell LLC; AP Armaflex</u>.
    - c. <u>K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS</u>.
- G. Noncombustible Plenum Insulation
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Unifrax I LLC, Niagrara Falls, NY FyreWrap 0.5 Plenum Insulation
  - 2. Materials
    - a. Nominal 0.50" thick foil encapsulated blanket material at 8 PCF to provide noncombustible rating.
    - b. An inorganic, non-asbestos, bio-soluable blanket material
    - c. Blanket insulation must maintain a 2012 deg. F operating temperature.

# 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

- 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. <u>Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; 81-84</u>.
- 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).
- 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Flexible Elastomeric and Polyolefin Adhesive:
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Aeroflex USA, Inc.; Aeroseal</u>.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Childers CP-82
    - d. <u>Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; 85-75</u>.
    - e. <u>K-Flex USA; R-373 Contact Adhesive</u>.
  - 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).
  - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive:
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; CP-82</u>.
    - b. <u>Eagle Bridges Marathon Industries; 225</u>.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60.
    - d. Mon-Eco Industries, Inc.; 22-25.
  - 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).
  - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

- 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. <u>Dow Corning Corporation; 739, Dow Silicone</u>.
  - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
  - c. <u>P.I.C. Plastics, Inc.; Welding Adhesive</u>.
  - 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).
- 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

# 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. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers CP-38
    - b. <u>Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; 30-80/30-90</u>.
    - c. <u>Vimasco Corporation; 749</u>.
  - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; CP-10</u>.
    - b. <u>Eagle Bridges Marathon Industries; 550</u>.
    - c. <u>Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; 46-50</u>.
    - d. Mon-Eco Industries, Inc.; 55-50.

- e. <u>Vimasco Corporation; WC-1/WC-5</u>.
- 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
- 4. Solids Content: 60 percent by volume and 66 percent by weight.
- 5. Color: White.

#### 2.4 SEALANTS

- A. Joint Sealants:
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; CP-76</u>.
    - b. Eagle Bridges Marathon Industries; 405.
    - c. <u>Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; 30-45, 95-50.</u>
    - d. <u>Mon-Eco Industries, Inc.; 44-05</u>.
    - e. <u>Pittsburgh Corning Corporation; Pittseal 444</u>.
    - f.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Permanently flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
  - 5. Color: White or gray.
  - 6. 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).
  - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. FSK and Metal Jacket Flashing Sealants:
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; CP-76</u>.
    - b. Eagle Bridges Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    - d. <u>Mon-Eco Industries, Inc.; 44-05</u>.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

- 5. Color: Aluminum.
- 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller</u> <u>Company; CP-76</u>.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
  - 5. Color: White.
  - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

# 2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

# 2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Chil Glas #10
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.

c. <u>Vimasco Corporation; Elastafab 894</u>.

# 2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Johns Manville; Zeston.
    - b. <u>P.I.C. Plastics, Inc.; FG Series</u>.
    - c. <u>Proto Corporation; LoSmoke</u>.
    - d. <u>Speedline Corporation; SmokeSafe</u>.
  - 2. Adhesive: As recommended by jacket material manufacturer.
  - 3. Color: White.
  - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>ITW Insulation Systems; Aluminum and Stainless Steel Jacketing</u>.
    - b. <u>RPR Products, Inc.; Insul-Mate</u>.
  - 2. Sheet and roll stock ready for shop or field sizing.
  - 3. Finish and thickness are indicated in field-applied jacket schedules.
  - 4. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
  - 5. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
  - 6. Factory-Fabricated Fitting Covers:
    - a. Same material, finish, and thickness as jacket.
    - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - c. Tee covers.
    - d. Flange and union covers.

- e. End caps.
- f. Beveled collars.
- g. Valve covers.
- h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>Polyguard Products, Inc.; Alumaguard 60</u>.

# 2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>ABI, Ideal Tape Division; 428 AWF ASJ</u>.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. <u>Compac Corporation; 104 and 105</u>.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  - 2. Width: 3 inches (75 mm).
  - 3. Thickness: 11.5 mils (0.29 mm).
  - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>ABI, Ideal Tape Division; 491 AWF FSK</u>.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. <u>Compac Corporation; 110 and 111</u>.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  - 2. Width: 3 inches (75 mm).
  - 3. Thickness: 6.5 mils (0.16 mm).

- 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
- 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>ABI, Ideal Tape Division; 370 White PVC tape</u>.
    - b. <u>Compac Corporation; 130</u>.
    - c. <u>Venture Tape; 1506 CW NS</u>.
  - 2. Width: 2 inches (50 mm).
  - 3. Thickness: 6 mils (0.15 mm).
  - 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
  - 5. Elongation: 500 percent.
  - 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>ABI, Ideal Tape Division; 488 AWF</u>.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - c. <u>Compac Corporation; 120</u>.
    - d. Venture Tape; 3520 CW.
  - 2. Width: 2 inches (50 mm).
  - 3. Thickness: 3.7 mils (0.093 mm).
  - 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
  - 5. Elongation: 5 percent.
  - 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

# 2.9 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide.
  - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. <u>ITW Insulation Systems; Gerrard Strapping and Seals</u>.
    - b. <u>RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs</u>.

- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy, 0.062-inch (1.6-mm) soft-annealed, stainless steel, or 0.062-inch (1.6-mm) soft-annealed, galvanized steel.
  - 1. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
    - a. <u>C & F Wire</u>.

# PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. If applicable, coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

# 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, 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 (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.

6. Cleanouts.

#### 3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in other sections 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.

# 3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  - 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
  - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  - 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

# 3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
  - 1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  - 3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
  - 4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. 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 cut sections of cellular-glass block insulation of same thickness as pipe insulation.
  - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:

- 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
- 2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed sections of cellular-glass insulation to valve body.
  - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Install insulation to flanges as specified for flange insulation application.

# 3.6 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 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

# 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of fittings and three locations of specialties such as valves, etc.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

# 3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable insulation and jacket materials are identified above. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- 3.10 INSULATION SCHEDULE: See the insulation schedule on the plans for insulation thickness, jacket requirements, etc.

# END OF SECTION 230719

# SECTION 230900 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

# PART 1 - GENERAL

# 1.1 SUMMARY

- A. Section Includes:
  - 1. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and ventilating units exhaust fans, dampers, VAV terminal units. All electrical wiring, raceways, breakers, transformers, final connections, and other miscellaneous equipment necessary to provide power to the Controls shall be provided as part of the Control system unless explicitly indicated in work of other Divisions. Convenience outlets and convenience outlet circuits shall not be used as a source of power.
  - 2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.
- B. Related Sections include the following:
  - 1. Division 22 Section "Domestic Water Piping Specialties" for measuring equipment that relates to this Section.
  - 2. Division 23 Section "Air Terminal Units" for requirements that relate to this Section
  - 3. Division 23 Section "Variable Frequency Motor Controllers" for requirements that relate to this Section.
  - 4. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
  - 5. Division 23 Section "Indoor Air Handling Units" for requirements that relate to this section.
  - 6. Division 23 Section "Packaged Rooftop Heating and Ventilating Units."

# 1.2 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:
  - 1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
  - 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.
- 4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
- 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. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.
- L. HLC: Heavy load conditions.
- M. 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.
- N. LAN: Local area network.
- O. LNS: LonWorks Network Services.
- P. 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.

- Q. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
- R. 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.
- S. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.
- T. PDA: Personal digital assistant.
- U. Peer to Peer: Networking architecture that treats all network stations as equal partners.
- V. POT: Portable operator's terminal.
- W. RAM: Random access memory.
- X. RF: Radio frequency.
- Y. Router: Device connecting two or more networks at network layer.
- Z. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- AA. UPS: Uninterruptible power supply.
- BB. USB: Universal Serial Bus.
- CC. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.
- DD. VAV: Variable air volume.
- EE. WLED: White light emitting diode.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 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.

- 3. Product description with complete technical data, performance curves, and product specification sheets.
- 4. Installation, operation and maintenance instructions including factors effecting performance.
- 5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
  - a. Operator workstations.
  - b. Gateways.
  - c. DDC controllers.
  - d. Enclosures.
  - e. Electrical power devices.
  - f. Accessories.
  - g. Instruments.
  - h. Control dampers and actuators.
  - i. Control valves and actuators.
- 6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
- 7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.
- B. Software Submittal:
  - 1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
  - 2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
  - 3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
  - 4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
  - 5. Listing and description of each engineering equation used with reference source.
  - 6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
  - 7. Description of operator interface to alphanumeric and graphic programming.
  - 8. Description of each network communication protocol.
  - 9. Description of system database, including all data included in database, database capacity and limitations to expand database.
  - 10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
  - 11. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- C. Shop Drawings:

- 1. Include plans, elevations, sections, and mounting details where applicable.
- 2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 3. Detail means of vibration isolation and show attachments to rotating equipment.
- 4. Plan Drawings indicating the following:
  - a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
  - b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
  - c. Each desktop operator workstation, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.
  - d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
  - e. Network communication cable and raceway routing.
  - f. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.
- 5. 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.
- 6. Control panel drawings indicating the following:
  - a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
  - b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
  - c. Front, rear, and side elevations and nameplate legend.
  - d. Unique drawing for each panel.
- 7. DDC system network riser diagram indicating the following:
  - a. Each device connected to network with unique identification for each.
  - b. Interconnection of each different network in DDC system.

- c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or fiber-optic cable type. Indicate raceway type and size for each.
- d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.
- 8. DDC system electrical power riser diagram indicating the following:
  - a. Each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
  - b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
  - c. Each product requiring power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
  - d. Power wiring type and size, race type, and size for each.
- 9. Monitoring and control signal diagrams indicating the following:
  - a. Control signal cable and wiring between controllers and I/O.
  - b. Point-to-point schematic wiring diagrams for each product.
  - c. Control signal tubing to sensors, switches and transmitters.
  - d. Process signal tubing to sensors, switches and transmitters.
- 10. Color graphics indicating the following:
  - a. Itemized list of color graphic displays to be provided.
  - b. For each display screen to be provided, a true color copy showing layout of pictures, graphics and data displayed.
  - c. Intended operator access between related hierarchical display screens.
- D. System Description:
  - 1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
  - 2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
  - 3. System and product operation under each potential failure condition including, but not limited to, the following:
    - a. Loss of power.
    - b. Loss of network communication signal.
    - c. Loss of controller signals to inputs and outpoints.
    - d. Operator workstation failure.
    - e. Gateway failure.
    - f. Network failure
    - g. Controller failure.
    - h. Instrument failure.
    - i. Control damper and valve actuator failure.

- 4. Complete bibliography of documentation and media to be delivered to Owner.
- 5. Description of testing plans and procedures.
- 6. Description of Owner training.
- E. Delegated-Design Submittal: For DDC system products and installation indicated as being delegated.
  - 1. Supporting documentation showing DDC system design complies with performance requirements indicated, including calculations and other documentation necessary to prove compliance.
  - 2. Schedule and design calculations for control dampers and actuators.
    - a. Flow at Project design and minimum flow conditions.
    - b. Face velocity at Project design and minimum airflow conditions.
    - c. Pressure drop across damper at Project design and minimum airflow conditions.
    - d. AMCA 500-D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
    - e. Maximum close-off pressure.
    - f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
    - g. Torque required at worst case condition for sizing actuator.
    - h. Actuator selection indicating torque provided.
    - i. Actuator signal to control damper (on, close or modulate).
    - j. Actuator position on loss of power.
    - k. Actuator position on loss of control signal.
  - 3. Schedule and design calculations for control valves and actuators.
    - a. Flow at Project design and minimum flow conditions.
    - b. Pressure-differential drop across valve at Project design flow condition.
    - c. Maximum system pressure-differential drop (pump close-off pressure) across valve at Project minimum flow condition.
    - d. Design and minimum control valve coefficient with corresponding valve position.
    - e. Maximum close-off pressure.
    - f. Leakage flow at maximum system pressure differential.
    - g. Torque required at worst case condition for sizing actuator.
    - h. Actuator selection indicating torque provided.
    - i. Actuator signal to control damper (on, close or modulate).
    - j. Actuator position on loss of power.
    - k. Actuator position on loss of control signal.
  - 4. Schedule and design calculations for selecting flow instruments.
    - a. Instrument flow range.
    - b. Project design and minimum flow conditions with corresponding accuracy, control signal to transmitter and output signal for remote control.
    - c. Extreme points of extended flow range with corresponding accuracy, control signal to transmitter and output signal for remote control.
    - d. Pressure-differential loss across instrument at Project design flow conditions.
    - e. Where flow sensors are mated with pressure transmitters, provide information for each instrument separately and as an operating pair.

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### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plan drawings, reflected ceiling plan(s), and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Qualification Data:
  - 1. Systems Provider Qualification Data:
    - a. Resume of project manager assigned to Project.
    - b. Resumes of application engineering staff assigned to Project.
    - c. Resumes of installation and programming technicians assigned to Project.
    - d. Resumes of service technicians assigned to Project.
    - e. Brief description of past project including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function.
    - f. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
    - g. Names of staff assigned to past project that will also be assigned to execute work of this Project.
    - h. Owner contact information for past project including name, phone number, and email address.
    - i. Contractor contact information for past project including name, phone number, and e-mail address.
    - j. Architect contact information for past project including name, phone number, and e-mail address.
  - 2. Manufacturer's qualification data.
  - 3. Testing agency's qualifications data.
- C. Welding certificates.
- D. Product Certificates:
  - 1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.
  - 2. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with LonWorks.
- E. Product Test Reports: For each product that requires testing to be performed by manufacturer.
- F. Preconstruction Test Reports: For each separate test performed.
- G. Source quality-control reports.
- H. Field quality-control reports.
- I. Sample Warranty: For manufacturer's warranty.

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# 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. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
    - g. Engineering, installation, and maintenance manuals that explain how to:
      - 1) Design and install new points, panels, and other hardware.
      - 2) Perform preventive maintenance and calibration.
      - 3) Debug hardware problems.
      - 4) Repair or replace hardware.
    - h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
    - i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
    - j. List of recommended spare parts with part numbers and suppliers.
    - k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
    - 1. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
    - m. Licenses, guarantees, and warranty documents.
    - n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
    - o. Owner training materials.

# 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- B. Include product manufacturers' recommended parts lists for proper product operation over fouryear period following warranty period. Parts list shall be indicated for each year.
- C. Furnish parts, as indicated by manufacturer's recommended parts list, for product operation during one-year period following warranty period.
- D. Furnish quantity indicated of matching product(s) in Project inventory for each unique size and type of following:
  - 1. Network Controller: One.
  - 2. Programmable Application Controller: One.
  - 3. Application-Specific Controller: One.
  - 4. Room Temperature Sensor and Transmitter: One.
  - 5. General-Purpose Relay: One.
  - 6. Multifunction Time-Delay Relay: One.
  - 7. Latching Relay: One.
  - 8. Current-Sensing Relay: One.
  - 9. Combination On-Off Status Sensor and On-Off Relay: One.
  - 10. Transformer: One.
  - 11. DC Power Supply: One.

### 1.8 QUALITY ASSURANCE

- A. DDC System Provider Qualifications:
  - 1. Authorized representative of, and trained by, DDC system manufacturer.
  - 2. In-place facility located within 100 miles of Project.
  - 3. Demonstrated past experience with installation of DDC system products being installed for period within five consecutive years before time of bid.
  - 4. Demonstrated past experience on five projects of similar complexity, scope and value.
  - 5. Each person assigned to Project shall have demonstrated past experience.
  - 6. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
  - 7. Service and maintenance staff assigned to support Project during warranty period.
  - 8. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.
  - 9. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum."
  - 3. AWS D1.3/D1.3M, "Structural Welding Code Sheet Steel."
- 4. AWS D1.4/D1.4M, "Structural Welding Code Reinforcing Steel."
- D. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- 1.9 PRECONSTRUCTION TESTING

#### 1.10 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 service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.
  - 4. Warranty Period: Two year(s) from date of Substantial Completion.
    - a. For Gateway: Three-year parts and labor warranty for each.

## PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Trane Tracer.

#### 2.2 ARCHITECTURE/COMMUNICATION

- A. This project shall be comprised of a high speed Ethernet network utilizing BACnet/IP communications between System Controllers and Workstations. Communications between System Controllers and sub-networks of Custom Application Controllers and/or Application Specific Controllers shall utilize BACnet MSTP (RS485) communications.
  - 1. Each System Controller shall perform communications to a network of Custom Application and Application Specific Controllers using BACnet/MSTP (RS485) as prescribed by the BACnet standard.
  - 2. Each System Controller shall function as a BACnet Router to each unit controller providing a unique BACnet Device ID for all controllers within the system.

3. The Controls Contractor shall provide all communication media, connectors, repeaters and network switches routers necessary for the high speed Ethernet communications network.

# 2.3 OPERATOR INTERFACE

a.

c.

- A. Furnish one PC based operator interface. Each operator interface shall be able to access all information in the system. Operator interfaces shall reside on the same high-speed network as the System Controller(s).
  - 1. As a miniumum, each PC based operator interface shall include the following:
    - Hardware type
    - 1) Laptop
    - b. Operating Systems
      - 1) Windows XP or later.
      - Minimum Hardware
        - 1) Pentium Core 2 DUO or better
        - 2) 16 GB RAM
        - 3) 500 GB hard drive space
        - 4) Internet Browser compatible with operator interface requirements outlined in the operator interface section
        - 5) Java Runtime Environment (JRE) V6.0 or higher
  - 2. Operator Interface
    - a. The operator interface shall be accessible via a web browser and shall not require the use of dongles, installed software or hardware.
    - b. The operator interface shall support the following Internet web browsers:
      - 1) Internet Explorer 8.0+
    - c. The operator interface shall support the following mobile web browsers:
      - 1) iOS (iPad/iPhone) V4.0+
    - d. Android (Phone) V2.3+
  - 3. Mobile App Operator Interface
    - a. Mobile App Operator Interface shall support the following Operating systems
      - 1) Apple iOS 5
      - 2) Apple iOS 6
      - 3) Android V2.3
      - 4) Android V4.0
      - 5) Android V4.1
    - b. The operator interface shall support system access on a mobile device via a mobile app to:
      - 1) Alarm log
      - 2) System Status
      - 3) Equipment status
      - 4) Space Status
      - 5) Standard Equipment graphics
    - c. The operator interface shall support actions on a mobile device via a mobile app to:
      - 1) Override set points
      - 2) Override occupancy
      - 3) Acknowledge Alarms
      - 4) Comment on Alarms

- d. System Security
  - 1) Each operator shall be required to login to the system with a user name and password in order to view, edit, add, or delete data.
  - 2) User Profiles shall restrict the user to only the objects, applications, and system functions as assigned by the system administrator.
  - 3) Each operator shall be allowed to change their user password
  - 4) The System Administrator shall be able to manage the security for all other users
  - 5) The system shall include pre-defined "roles" that allow a system administrator to quickly assign permissions to a user.
  - 6) User logon/logoff attempts shall be recorded.
  - 7) The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
  - 8) All system security data shall be stored in an encrypted format.
- e. Database
  - 1) Database Save. A system operator with the proper password clearance shall be able to archive the database on the designated operator interface PC.
  - 2) Database Restore. The system operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
- f. On-Line Help and Training
  - 1) Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.
  - 2) On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.
- g. System Diagnostics
  - 1) The system shall automatically monitor the operation of all network connections, building management panels, and controllers.
  - 2) The failure of any device shall be annunciated to the operators.
- h. Equipment & Application Pages
  - 1) The operator interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:
    - a) Animated Equipment Graphics for each major piece of equipment and floor plan in the System. This includes: Each Air Handler, VAV Terminal, Fan Coil. These graphics shall show all points dynamically as specified in the points list. Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.
    - b) Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.
    - c) Historical Data (As defined in Automatic Trend Log section below) for the equipment or application without requiring a user to navigate to a data log page and perform a filter.
- i. System Graphics. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on

floor plan summary graphics using colors to represent zone temperature relative to zone set point.

- 1) Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point and-click navigation between zones or equipment, and to edit set points and other specified parameters.
- Graphic imagery graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.
- 3) Animation. Graphics shall be able to animate by displaying different Image lies for changed object status.
- 4) Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
- 5) Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).
- j. Custom Graphics
  - 1) The operator interface shall be capable of displaying custom graphics in order to convey the status of the facility to its operators.
  - 2) Graphical Navigation. The operator interface shall provide dynamic color graphics of building areas, systems and equipment.
  - 3) Graphical Data Visualization. The operator interface shall support dynamic points including analog and binary values, dynamic text, static text, and animation files.
  - 4) Custom background images. Custom background images shall be created with the use of commonly available graphics packages such as Adobe Photoshop. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as GIF and JPEG.
- K. Graphics Library. Furnish a library of standard HVAC equipment such as chillers, air handlers, terminals, fan coils, unit ventilators, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.
- 1. Manual Control and Override.
  - 1) Point Control. Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs.
  - 2) Temporary Overrides. The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.
  - 3) Override Owners. The system shall convey to the user the owner of each override for all priorities that an override exists.
  - 4) Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.
- m. Engineering Units
  - 1) Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system.

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- 2) Unit selection shall be able to be customized by locality to select the desired units for each measurement.
- 3) Engineering units on this project shall be IP.
- 4. Scheduling. A user shall be able to perform the following tasks utilizing the operator interface:
  - a. Create a new schedule, defining the default values, events and membership.
  - b. Create exceptions to a schedule for any given day.
  - c. Apply an exception that spans a single day or multiple days.
  - d. View a schedule by day, week and month.
  - e. Exception schedules and holidays shall be shown clearly on the calendar.
  - f. Modify the schedule events, members and exceptions.
- 5. Trend Logs
  - a. Trend Logs Definition.
    - 1) The operator interface shall allow a user with the appropriate security permissions to define a trend log for any data in the system.
    - 2) The operator interface shall allow a user to define any trend log options as described in the Application and Control Software section.
  - b. Trend Log Viewer.
    - 1) The operator interface shall allow Trend Log data to be viewed and printed.
    - 2) The operator interface shall allow a user to view trend log data in text-based (time –stamp/value).
    - 3) The operator shall be able to view the data collected by a trend log in a graphical chart in the operator interface.
    - 4) Trend log viewing capabilities shall include the ability to show a minimum of 5 points on a chart.
    - 5) Each data point trend line shall be displayed as a unique color.
    - 6) The operator shall be able to specify the duration of historical data to view by scrolling and zooming.
    - 7) The system shall provide a graphical trace display of the associated time stamp and value for any selected point along the x-axis.
  - c. Export Trend Logs.
    - 1) The operator interface shall allow a user to export trend log data in CSV or PDF format for use by other industry standard word processing and spreadsheet packages.
- 6. Alarm/Event Notification
  - a. An operator shall be notified of new alarms/events as they occur while navigating through any part of the system via an alarm icon.
  - b. Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any operator interface.
    - 1) The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 4 categories based on severity.
    - 2) Alarm/event messages shall use full language, easily recognized descriptors.
    - 3) An operator with the proper security level may acknowledge and clear alarms/events.
    - 4) All alarms/events that have not been cleared by the operator shall be stored by the building controller.
    - 5) The alarm/event log shall include a comment field for each alarm/event that allows a user to add specific comments associated with any alarm.
  - c. Alarm Processing.

- 1) The operator shall be able to configure any object in the system to generate an alarm when transitioning in and out of a normal state.
- 2) The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
- 7. Reports and Logs.
  - a. The operator interface shall provide a reporting package that allows the operator to select reports.
  - b. The operator interface shall provide the ability to schedule reports to run at specified intervals of time.
  - c. The operator interface shall allow a user to export reports and logs from the building controller in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Acceptable formats include:
    - 1) CSV, HTML, XML, PDF
  - d. Reports and logs shall be readily printed to the system printer.
  - e. Provide a means to list and access the last 10 reports viewed by the user.
  - f. The following standard reports shall be available without requiring a user to manually configure the report:
    - 1) All Points in Alarm Report: Provide an on demand report showing all current alarms.
    - 2) All Points in Override Report: Provide an on demand report showing all overrides in effect.
    - 3) Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
    - 4) Points report: Provide a report that lists the current value of all points
- 8. VAV Air System. An operator shall be able to view and control (where applicable) the following parameters via the operator interface:
  - a. System Mode
  - b. System Occupancy
  - c. Ventilation (Outdoor air flow) setpoint
  - d. Ventilation (Outdoor air flow) status
  - e. Air Handler Static pressure setpoint
  - f. Air Handler Static pressure status
  - g. Air Handler occupancy status
  - h. Air Handler Supply air cooling and heating set points
  - i. Air Handler minimum, maximum and nominal static pressure setpoints
  - j. VAV box minimum and maximum flow
  - k. VAV box drive open and close overrides
  - 1. VAV box occupancy status
  - m. VAV box Airflow to space
  - n. Average space temperature
  - o. Minimum space temperature
  - p. Maximum space temperature
- 9. Custom Application Programming. Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded.

10. Custom Graphic Editor. Provide the tools to create, modify, and debug custom graphics. The operator shall be able to create, edit, and download custom graphics at the same time that all other system applications are operating. The system shall be fully operable while custom graphics are edited, compiled, and downloaded.

# 2.4 APPLICATION AND CONTROL SOFTWARE

- A. Provide the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator interface.
  - 1. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:
    - a. Weekly Schedule. Provide separate schedules for each day of the week.
    - b. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
    - c. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
    - d. Optimal Start. The scheduling application outlined above shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less then and greater than 24 hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.
  - 2. Trend Log Application
    - a. Trend log data shall be sampled and stored on the System Controller panel and shall capable of being archived to a BACnet Workstation for longer term storage.
      - 1) Trend logs shall include interval, start-time, and stop-time.
      - 2) Trend log intervals shall be configurable as frequently as 1 minute and as infrequently as 1 year.
    - b. Automated Trend Logs.
      - 1) The system controller shall automatically create trend logs for defined key measurements for each controlled HVAC device and HVAC application.
      - 2) The automatic trend logs shall monitor these parameters for a minimum of 7 days at 15 minute intervals. The automatic trend logs shall be user adjustable.
      - 3) The following is a list of key measurements required for Automatic Trending:
        - a) Air and Hydronic Systems:

Air Handling Unit/Rooftop	Discharge Air Temperature
(VAV)	
	Discharge Air Temperature Set-
	point Active
	Space Temperature Active
	Cooling Capacity Status
	Discharge Air Flow
VAV Box	Discharge Air Temperature
	Space Temperature Active
	Space Temperature Setpoint Active
	Air Flow Setpoint Active
	Discharge Air Flow
Variable Air System	Duct Static Optimization Duct Static
	Setpoint
	Space Temperature Average
	Ventilation Optimization Air Set-
	point
	Operating Mode
	Duct Pressure Optimization Maxi-
	mum
Variable Hydronic System	Pump Pressure Optimization Pres-
	sure Setpoint
	System Entering Water Tempera-
	ture and System Leaving water
	Temperature

Reference Contract drawings for additional requirements.

- 3. Alarm/Event Log
  - a. Any object in the system shall be configurable to generate an alarm when transitioning in and out of a normal or fault state.
  - b. Any object in the system shall allow the alarm limits, warning limits, states, and reactions to be configured for each object in the system.
  - c. An alarm/event shall be capable of triggering any of the following actions:
    - 1) Route the alarm/event to one or more alarm log
      - a) The alarm message shall include the name of the alarm location, the device that generated the alarm, and the alarm message itself.
    - 2) Route an e-mail message to an operator(s)
    - 3) Log a data point(s) for a period of time
    - 4) Run a custom control program
- 4. VAV System Coordination. Provide applications software to properly coordinate and control the VAV system to ensure equipment safety and minimize energy use. This application shall perform the following functions:

- a. Startup and shutdown the air handler safely. Ensure the VAV boxes are open sufficiently when the air handler is running, to prevent damage to the ductwork and VAV boxes due to high air pressure.
- b. Calibrate VAV boxes.
- c. Fan Pressure Optimization (ASHRAE 90.1) Minimize energy usage by controlling system static pressure to the lowest level while maintaining zone airflow requirements. System static pressure controlled to keep the "most open" zone damper between 65% and 75% open.
  - 1) The Fan Pressure Optimization application shall have the ability to identify and display the discharge air setpoint of the air-handler and the VAV box that serves the critical zone (e.g., the zone with the most open VAV box damper). This information shall dynamically update with changes in the location of the critical zone.
  - 2) During commissioning, and with the engineer/owner, the controls contractor shall confirm the performance of Fan Pressure Optimization by conducting a field functional test that demonstrates critical zone reset.
- d. Ventilation Optimization (ASHRAE 62) properly ventilate all spaces while minimizing operating energy costs, using measured outdoor air flow. Dynamically calculate the system outdoor air requirement based on "real time" conditions in the spaces (i.e., number of occupants, CO2 levels, etc.) minimizing the amount of unconditioned outdoor air that must be brought into the building.
- e. Demand Controlled Ventilation the active ventilation setpoint shall modulate between the occupied ventilation and occupied standby ventilation setpoint; Reset the setpoint based on CO2 levels in the space.
- 5. Point Control. User shall have the option to set the update interval, minimum on/off time, event notification, custom programming on change of events.
- 6. Timed Override. A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, operator interface, or the local operator display. The amount of time that the override takes precedence will be selectable from the operator interface.
- 7. Anti-Short Cycling. All binary output points shall be protected from short cycling
- 8. Variable Flow Hydronic System Coordination. Provide applications software to properly coordinate and control the variable flow hydronic system to ensure equipment safety and minimize energy use. This application shall perform the following functions:
  - a. Startup and shutdown the pump. Ensure control balves are open sufficiently when the pump is running, to prevent damage to the pump.
  - b. Calibrate control valves.
  - c. Pump Pressure Optimization Minimize energy usage by controlling system differential pressure to the lowest level while maintaining zone water flow requirements. System differential pressure controlled to keep the "most open" control valve between 65% and 75% open.
    - 1) During commissioning, and with the engineer/owner, the controls contractor shall confirm the performance of Pump Pressure Optimization by conducting a field functional test that demonstrates critical zone reset.

## 2.5 SYSTEM CONTROLLERS

- A. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in Application and Control Software section.
  - 1. The System Controller shall have sufficient memory to support its operating system, database, and programming requirements.
  - 2. The controller shall provide a USB communications port for connection to a PC
  - 3. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
  - 4. All System Controllers shall have a real time clock.
  - 5. Data shall be shared between networked System Controllers.
  - 6. The System Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
    - a. Assume a predetermined failure mode.
    - b. Generate an alarm notification.
    - c. Create a retrievable file of the state of all applicable memory locations at the time of the failure.
    - d. Automatically reset the System Controller to return to a normal operating mode.
  - 7. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at -40 C to 50 C.
  - 8. Clock Synchronization.
    - a. All System Controllers shall be able to synchronize with a NTP server for automatic time synchronization.
    - b. All System Controllers shall be able to accept a BACnet time synchronization command for automatic time synchronization.
    - c. All System Controllers shall automatically adjust for daylight savings time if applicable.
  - 9. Serviceability
    - a. Provide diagnostic LEDs for power, communications, and processor.
    - b. The System Controller shall have a display on the main board that indicates the current operating mode of the controller.
    - c. All wiring connections shall be made to field removable, modular terminal connectors.
    - d. The System controller shall utilize standard DIN mounting methods for installation and replacement.
  - 10. Memory. The System Controller shall maintain all BIOS and programming information indefinitely without power to the System controller
  - 11. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage
  - 12. BACnet Test Labs (BTL) Listing. Each System Controller shall be listed as a Building Controller (B-BC) by the BACnet Test Labs.

## 2.6 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated.

- 1. System Performance Objectives:
  - a. DDC system shall manage HVAC systems.
  - b. DDC system control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.
  - c. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
  - d. DDC system shall operate while unattended by an operator and through operator interaction.
  - e. DDC system shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.
- B. 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.
- C. DDC System Speed:
  - 1. Response Time of Connected I/O:
    - a. AI point values connected to DDC system shall be updated at least every five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
    - b. BI point values connected to DDC system shall be updated at least every five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
    - c. AO points connected to DDC system shall begin to respond to controller output commands within two second(s). Global commands shall also comply with this requirement.
    - d. BO point values connected to DDC system shall respond to controller output commands within two second(s). Global commands shall also comply with this requirement.
  - 2. Display of Connected I/O:
    - a. Analog point COV connected to DDC system shall be updated and displayed at least every 10 seconds for use by operator.
    - b. Binary point COV connected to DDC system shall be updated and displayed at least every 10 seconds for use by operator.
    - c. Alarms of analog and digital points connected to DDC system shall be displayed within 45 seconds of activation or change of state.
    - d. Graphic display refresh shall update within four seconds.
    - e. Point change of values and alarms displayed from workstation to workstation when multiple operators are viewing from multiple workstations shall not exceed graphic refresh rate indicated.

- D. Network Bandwidth: Design each network of DDC system to include at least 30 percent available spare bandwidth with DDC system operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.
- E. Future Expandability:
  - 1. DDC system size shall be expandable to an ultimate capacity of at least two times total I/O points indicated.
  - 2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.
  - 3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.
- F. Input Point Displayed Accuracy: Input point displayed values shall meet following end-to-end overall system accuracy, including errors associated with meter, sensor, transmitter, lead wire or cable, and analog to digital conversion.
  - 1. Flow:
    - a. Air: Within 5 percent of design flow rate.
    - b. Air (Terminal Units): Within 10 percent of design flow rate.
    - c. Water: Within 2 percent of design flow rate.
  - 2. Moisture (Relative Humidity):
    - a. Air: Within 2 percent RH.
    - b. Space: Within 2 percent RH.
    - c. Outdoor: Within 2 percent RH.
  - 3. Pressure:
    - a. Air, Ducts and Equipment: 1 percent of instrument range.
    - b. Space: Within 1 percent of instrument range.
    - c. Water: Within 1 percent of instrument range.
  - 4. Speed: Within 5 percent of reading.
  - 5. Temperature, Dew Point:
    - a. Air: Within 0.5 deg F.
    - b. Space: Within 0.5 deg F.
    - c. Outdoor: Within 2 deg F.
  - 6. Temperature, Dry Bulb:
    - a. Air: Within 0.5 deg F.
    - b. Space: Within 0.5 deg F.
    - c. Outdoor: Within 1 deg F.
    - d. Heating Hot Water: Within 1 deg F.
    - e. Temperature Difference: Within 0.25 deg F.

- f. Other Temperatures Not Indicated: Within 1 deg F.
- 7. Temperature, Wet Bulb:
  - a. Air: Within 0.5 deg F.
  - b. Space: Within 0.5 deg F.
  - c. Outdoor: Within 1 deg F.
- G. Precision of I/O Reported Values: Values reported in database and displayed shall have following precision:
  - 1. Current:
    - a. Milliamperes: Nearest 1/100th of a milliampere.
    - b. Amperes: Nearest 1/10th of an ampere up to 100 A; nearest ampere for 100 A and more.
  - 2. Flow:
    - a. Air: Nearest 1/10th of a cfm through 100 cfm; nearest cfm between 100 and 1000 cfm; nearest 10 cfm between 1000 and 10,000 cfm; nearest 100 cfm above 10,000 cfm.
    - b. Water: Nearest 1/10th gpm through 100 gpm; nearest gpm between 100 and 1000 gpm; nearest 10 gpm between 1000 and 10,000 gpm; nearest 100 gpm above 10,000 gpm.
    - c. Steam: Nearest 1/10th lb/hr through 100 lbs/hr; nearest lbs/hr between 100 and 1000 lbs/hr; nearest 10 lbs/hr above 1000 lbs/hr.
  - 3. Gas:
    - a. Carbon Dioxide (ppm): Nearest ppm.
  - 4. Moisture (Relative Humidity):
    - a. Relative Humidity (Percentage): Nearest 1 percent.
  - 5. Level: Nearest 1/100th of an inch through 10 inches, nearest 1/10 of an inch between 10 and 100 inches, nearest inch above 100 inches.
  - 6. Speed:
    - a. Rotation (rpm): Nearest 1 rpm.
    - b. Velocity: Nearest 1/10th fpm through 100 fpm; nearest fpm between 100 and 1000 fpm; nearest 10 fpm above 1000 fpm.
  - 7. Position, Dampers and Valves (Percentage Open): Nearest 1 percent.
  - 8. Pressure:
    - a. Air, Ducts and Equipment: Nearest 1/10th in. w.c..
    - b. Space: Nearest 1/100th in. w.c..
    - c. Water: Nearest 1/10 psig through 100 psig, nearest psig above 100 psig.

- 9. Temperature:
  - a. Air, Ducts and Equipment: Nearest 1/10th of a degree.
  - b. Outdoor: Nearest degree.
  - c. Space: Nearest 1/10th of a degree.
  - d. Chilled Water: Nearest 1/10th of a degree.
  - e. Condenser Water: Nearest 1/10th of a degree.
  - f. Heating Hot Water: Nearest degree.
  - g. Heat Recovery Runaround: Nearest 1/10th of a degree.
  - h. Steam: Nearest degree.
- 10. Vibration: Nearest 1/10th in/s.
- 11. Voltage: Nearest 1/10 volt up to 100 V; nearest volt above 100 V.
- H. Environmental Conditions for Controllers, Gateways, and Routers:
  - 1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.
    - a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.
  - 2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products 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. Outdoors, Protected: Type 3R.
    - b. Outdoors, Unprotected: Type 4X.
    - c. Indoors, Heated with Filtered Ventilation: Type 2.
    - d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
    - e. Indoors, Heated and Air Conditioned: Type 1.
    - f. Mechanical Equipment Rooms:
      - 1) Air-Moving Equipment Rooms: Type 2 Type 12 Insert type.
    - g. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2.
    - h. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4X.
    - i. Hazardous Locations: Explosion-proof rating for condition.
- I. 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.

- a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and ventilated as required by instrument and application.
- 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. Outdoors, Protected: Type 3R.
  - b. Outdoors, Unprotected: Type 4X.
  - c. Indoors, Heated with Filtered Ventilation: Type 2.
  - d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
  - e. Indoors, Heated and Air Conditioned: Type 1.
  - f. Mechanical Equipment Rooms:
    - 1) Air-Moving Equipment Rooms: Type 2 Type 12 Insert type.
  - g. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2.
- J. Electric Power Quality:
  - 1. Power-Line Surges:
    - a. Protect susceptible DDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41.
    - b. Do not use fuses for surge protection.
    - c. Test protection in the normal mode and in the common mode, using the following two waveforms:
      - 1) 10-by-1000-mic.sec. waveform with a peak voltage of 1500 V and a peak current of 60 A.
      - 2) 8-by-20-mic.sec. waveform with a peak voltage of 1000 V and a peak current of 500 A.
  - 2. Power Conditioning:
    - a. Protect susceptible DDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:
      - At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
      - 2) During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
      - 3) Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.
      - 4) Total harmonic distortion shall not exceed 3-1/2 percent at full load.

- 3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.
- K. Continuity of Operation after Electric Power Interruption:
  - 1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

# 2.7 POT

- A. Description: Handheld device with integral keypad or touch screen operator interface.
- B. Display: Multiple lines of text display for use in operator interaction with DDC system.
- C. Cable: Flexiblecable, at least 36 inches long, with a plug-in jack for connection to DDC controllers, network ports or instruments with an integral LAN port. As an alternative to hardwired connection, POT shall be accessible to DDC controllers through a wireless network connection.
- D. POT shall be powered through network connection.
- E. Connection of POT to DDC system shall not interrupt or interfere with normal network operation in any way, prevent alarms from being transmitted, or preclude central initiated commands and system modification.
- F. POT shall give operator the ability to do the following:
  - 1. Display and monitor BI point status.
  - 2. Change BO point set point (on or off, open or closed).
  - 3. Display and monitor analog point values.
  - 4. Change analog control set points.
  - 5. Command a setting of AO point.
  - 6. Display and monitor I/O point in alarm.
  - 7. Add a new or delete an existing I/O point.
  - 8. Enable and disable I/O points, initiators, and programs.
  - 9. Display and change time and date.
  - 10. Display and change time schedules.
  - 11. Display and change run-time counters and run-time limits.
  - 12. Display and change time and event initiation.
  - 13. Display and change control application and DDC parameters.
  - 14. Display and change programmable offset values.
  - 15. Access DDC controller initialization routines and diagnostics.

#### 2.8 ASHRAE 135 GATEWAYS

- A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, air handling units and variable-speed drives.
- B. Include gateways to connect BACnet to legacy systems, existing non-BACnet devices, and existing non-BACnet DDC-controlled equipment, only when specifically requested and approved by Owner.
- C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.
- D. Gateway Minimum Requirements:
  - 1. Read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
  - 2. Write to all writeable object properties on non-BACnet network from BACnet network and vice versa where applicable.
  - 3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
  - 4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Binding-B, and Device Management Communication Control BIBBs according to ASHRAE 135.
  - 5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
  - 6. Backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.

## 2.9 ENCLOSURES

- A. General Enclosure Requirements:
  - 1. House each controller and associated control accessories in aenclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
  - 2. Do not house more than one controller in a single enclosure.
  - 3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
  - 4. Equip doors of enclosures housing controllers and components with analog or digital displays with windows to allow visual observation of displays without opening enclosure door.
  - 5. Individual wall-mounted single-door enclosures shall not exceed 36 inches wide and 48 inches high.
  - 6. Include wall-mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as indicated.

- 7. Supply each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature located in a pocket on inside of door. For enclosures with windows, include pocket on bottom of enclosure.
- B. Internal Arrangement:
  - 1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.
  - 2. Arrange layout to group similar products together.
  - 3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
  - 4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
  - 5. Terminate field cable and wire using heavy-duty terminal blocks.
  - 6. Include spare terminals, equal to not less than 10 Insert number percent of used terminals.
  - 7. Include spade lugs for stranded cable and wire.
  - 8. Install a maximum of two wires on each side of a terminal.
  - 9. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
  - 10. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.
  - 11. Mount products within enclosure on removable internal panel(s).
  - 12. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch-high lettering.
  - 13. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.
  - 14. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.
- C. Environmental Requirements:
  - 1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
  - 2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
  - 3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
  - 4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.

# 2.10 RELAYS

- A. General-Purpose Relays:
  - 1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.

- 2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
- 3. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
- 4. Construct the contacts of either silver cadmium oxide or gold.
- 5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
- 6. Relays shall have LED indication and a manual reset and push-to-test button.
- 7. Performance:
  - a. Mechanical Life: At least 10 million cycles.
  - b. Electrical Life: At least 100,000 cycles at rated load.
  - c. Pickup Time: 15 ms or less.
  - d. Dropout Time: 10 ms or less.
  - e. Pull-in Voltage: 85 percent of rated voltage.
  - f. Dropout Voltage: 50 percent of nominal rated voltage.
  - g. Power Consumption: 2 VA.
  - h. Ambient Operating Temperatures: Minus 40 to 115 deg F.
- 8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
- 9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
- 10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.
- B. Multifunction Time-Delay Relays:
  - 1. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
  - 2. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
  - 3. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
  - 4. Construct the contacts of either silver cadmium oxide or gold.
  - 5. Enclose the relay in a dust-tight cover.
  - 6. Include knob and dial scale for setting delay time.
  - 7. Performance:
    - a. Mechanical Life: At least 10 million cycles.
    - b. Electrical Life: At least 100,000 cycles at rated load.
    - c. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
    - d. Repeatability: Within 2 percent.
    - e. Recycle Time: 45 ms.
    - f. Minimum Pulse Width Control: 50 ms.
    - g. Power Consumption: 5 VA or less at 120-V ac.
    - h. Ambient Operating Temperatures: Minus 40 to 115 deg F.
  - 8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
  - 9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
  - 10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.
- C. Latching Relays:

## ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON

- 1. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
- 2. Relays shall be either DPDT or three-pole double throw, depending on the control application.
- 3. Use a plug-in-style relay with a multibladed plug.
- 4. Construct the contacts of either silver cadmium oxide or gold.
- 5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
- 6. Performance:
  - a. Mechanical Life: At least 10 million cycles.
  - b. Electrical Life: At least 100,000 cycles at rated load.
  - c. Pickup Time: 15 ms or less.
  - d. Dropout Time: 10 ms or less.
  - e. Pull-in Voltage: 85 percent of rated voltage.
  - f. Dropout Voltage: 50 percent of nominal rated voltage.
  - g. Power Consumption: 2 VA.
  - h. Ambient Operating Temperatures: Minus 40 to 115 deg F.
- 7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
- 8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
- 9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.
- D. Current Sensing Relay:
  - 1. Monitors ac current.
  - 2. Independent adjustable controls for pickup and dropout current.
  - 3. Energized when supply voltage is present and current is above pickup setting.
  - 4. De-energizes when monitored current is below dropout current.
  - 5. Dropout current is adjustable from 50 to 95 percent of pickup current.
  - 6. Include a current transformer, if required for application.
  - 7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.
- E. Combination On-Off Status Sensor and On-Off Relay:
  - 1. Description:
    - a. On-off control and status indication in a single device.
    - b. LED status indication of activated relay and current trigger.
    - c. Closed-Open-Auto override switch located on the load side of the relay.
  - 2. Performance:
    - a. Ambient Temperature: Minus 30 to 140 deg F.
    - b. Voltage Rating: Single-phase loads rated for 300-V ac. Three-phase loads rated for 600-V ac.
  - 3. Status Indication:
    - a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.

- b. Current Sensor Range: As required by application.
- c. Current Set Point: Fixed or adjustable as required by application.
- d. Current Sensor Output:
  - 1) Solid-state, single-pole double-throw contact rated for 30-V ac and dc and for 0.4 A.
  - 2) Solid-state, single-pole double-throw contact rated for 120-V ac and 1.0 A.
  - 3) Analog, zero- to 5- or 10-V dc.
  - 4) Analog, 4 to 20 mA, loop powered.
- 4. Relay: Single-pole double-throw, continuous-duty coil; rated for 10-million mechanical cycles.
- 5. Enclosure: NEMA 250, Type 1 enclosure.

# 2.11 ELECTRICAL POWER DEVICES

- A. Transformers:
  - 1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
  - 2. Transformer shall be at least 100 VA.
  - 3. Transformer shall have both primary and secondary fuses.
- B. DC Power Supply:
  - 1. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
  - 2. Enclose circuitry in a housing.
  - 3. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
  - 4. Performance:
    - a. Output voltage nominally 25-V dc within 5 percent.
    - b. Output current up to 100 mA.
    - c. Input voltage nominally 120-V ac, 60 Hz.
    - d. Load regulation within 0.5 percent from zero- to 100-mA load.
    - e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
    - f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

#### 2.12 CONTROL WIRE AND CABLE

- A. Wire: Single conductor control wiring above 24 V.
  - 1. Wire size shall be at least No. 14 AWG.
  - 2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5-inch lay.
  - 3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
  - 4. Conductor colors shall be black (hot), white (neutral), and green (ground).
  - 5. Furnish wire on spools.

- B. Single Twisted Shielded Instrumentation Cable above 24 V:
  - 1. Wire size shall be a minimum No. 18 AWG.
  - 2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch lay.
  - 3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
  - 4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
  - 5. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
  - 6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
  - 7. Furnish wire on spools.
- C. Single Twisted Shielded Instrumentation Cable 24 V and Less:
  - 1. Wire size shall be a minimum No. 18 AWG.
  - 2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch lay.
  - 3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
  - 4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
  - 5. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable.
  - 6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
  - 7. Furnish wire on spools.
- D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.
  - 1. Cable shall be plenum rated.
  - 2. Cable shall comply with NFPA 70.
  - 3. Cable shall have a unique color that is different from other cables used on Project.
  - 4. Copper Cable for Ethernet Network:
    - a. 1000BASE-T or 1000BASE-TX.
    - b. TIA/EIA 586, Category 6.
    - c. Minimum No. 22 AWG solid.
    - d. Shielded Twisted Pair (STP).
    - e. Thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, Class CMP as plenum rated.

#### 2.13 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. ARC: Comply with NEMA ANSI C80.5 and UL 6A.
- 4. IMC: Comply with NEMA ANSI C80.6 and UL 1242.
- 5. PVC-Coated Steel Conduit: PVC-coated IMC.
  - a. Comply with NEMA RN 1.
  - b. Coating Thickness: 0.040 inch, minimum.
- 6. EMT: Comply with NEMA ANSI C80.3 and UL 797.
- 7. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- 8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- 9. Fittings for Metal Conduit: Comply with NEMA ANSI FB 1 and UL 514B.
  - a. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
  - b. Fittings for EMT:
    - 1) Material: Steel or die cast.
    - 2) Type: Setscrew.
  - c. 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.
  - d. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- 10. 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.
- B. Metal Wireways and Auxiliary Gutters:
  - 1. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
    - a. 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.
  - 2. 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.
  - 3. Wireway Covers: Screw-cover type unless otherwise indicated.
  - 4. Finish: Manufacturer's standard enamel finish.
- C. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.

#### 2.14 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.
- 2.15 ACCESSORIES
  - A. Damper Blade Limit Switches:
    - 1. Sense positive open and/or closed position of the damper blades.
    - 2. NEMA 250, Type 13, oil-tight construction.
    - 3. Arrange for the mounting application.
    - 4. Additional waterproof enclosure when required by its environment.
    - 5. Arrange to prevent "over-center" operation.
  - B. Manual Valves:
    - 1. Needle Type:
      - a. PTFE packing.
      - b. Construct of brass for use with copper and polyethylene tubing and of stainless steel for use with stainless-steel tubing.
      - c. Aluminum T-bar handle.
      - d. Include tubing connections.
    - 2. Ball Type:
      - a. Body: Bronze ASTM B 62 or ASTM B 61.
      - b. Ball: Type 316 stainless steel.
      - c. Stem: Type 316 stainless steel.
      - d. Seats: Reinforced PTFE.
      - e. Packing Ring: Reinforced PTFE.
      - f. Lever: Stainless steel with a vinyl grip.
      - g. 600 WOG.
      - h. Threaded end connections.

#### 2.16 IDENTIFICATION

- A. Control Equipment, Instruments, and Control Devices:
  - 1. Engraved tag bearing unique identification.
    - a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.
  - 2. Tag shall consist of white lettering on black background.

- 3. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer.
- 4. Tag shall be fastened with drive pins.
- 5. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.
- B. 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.
- C. Raceway and Boxes:
  - 1. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  - 2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.
- D. Equipment Warning Labels:
  - 1. Acrylic label with pressure-sensitive adhesive back and peel-off protective jacket.
  - 2. Lettering size shall be at least 14-point type with white lettering on red background.
  - 3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
  - 4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inchbeyond white border.

## 2.17 SOURCE QUALITY CONTROL

- A. Product(s) and material(s) will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

# 2.18 FLOW MEASURING STATIONS

A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.

- 1. Available Manufacturers:
  - a. Ebtron (Add 003)
  - b. Air Monitor Corporation.
  - c. Wetmaster Co., Ltd.
- 2. Casing: Galvanized-steel frame.
- 3. Flow Straightener: Aluminum honeycomb, 3/4-inch (20-mm) parallel cell, 3 inches (75 mm) deep.
- 4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.
- B. Fan Inlet Airflow Station: Face mounted multiple sensors.
  - 1. Available Manufacturer:
    - a. Ebtron
  - 2. Sensor Assembly: Hermetically sealed bead in glass heated element thermistor, glass filled polypropylene sensor housing, marine grade waterproof epoxy potting material.
  - 3. Output: Analog.
  - 4. Accuracy:
  - 5. Cable Assembly: Plenum rated, PVC jacket.
  - 6. Transmitter: BACnet.

#### 2.19 DAMPERS

- A. Dampers: AMCA-rated, opposed-blade design; 0.108-inch minimum thick, galvanized-steel or 0.125-inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
  - 1. Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
  - 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
  - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
- B. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft.of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

## 2.20 CONTROL VALVES

- A. Control Valves: Factory fabricated, globe type; body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Hydronic system globe valves shall have the following characteristics:

- 1. NPS 2 and Smaller: Class 250 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
- 2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
- 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
  - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
  - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
- 4. Sizing: 5-psig maximum pressure drop at design flow rate or the following:
  - a. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
  - b. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
- 5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; threeway valves shall have linear characteristics.
- 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- C. Terminal Unit Glove Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
  - 1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
  - 2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
  - 3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; threeway valves shall have linear characteristics.

# 2.21 VARIABLE FREQUENCY MOTOR CONTROLLERS

A. Variable Frequency Motor Controllers: In accordance with Division 23 Section "Variable Frequency Motor Controllers."

## 2.22 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
  - 1. Available Manufacturers:
    - a. Belimo Aircontrols (USA), Inc. (No substitutes).
  - 2. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

- 3. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
- 4. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf.
- 5. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
- 6. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
- 7. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
  - 1. Available Manufacturers:
    - a. Belimo Aircontrols (USA), Inc. (No substitutes).
  - 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
  - 3. Dampers: Size for running torque calculated as follows:
    - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft.of damper.
    - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
    - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft.of damper.
    - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
    - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
  - 4. Coupling: V-bolt and V-shaped, toothed cradle.
  - 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  - 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
  - 7. Power Requirements (Two-Position Spring Return): 24-V ac.
  - 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
  - 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
  - 10. Temperature Rating: Minus 22 to plus 122 deg F.
  - 11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
  - 12. Run Time: 12 seconds open, 5 seconds closed.

## 2.23 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

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- B. Thermistor Temperature Sensors and Transmitters:
  - 1. Accuracy: Plus or minus 0.36 deg F at calibration point.
  - 2. Wire: Twisted, shielded-pair cable.
  - 3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
  - 4. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
  - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
  - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
    - a. Set-Point Adjustment: Concealed.
    - b. Set-Point Indication: Exposed.
    - c. Thermometer: Exposed.
    - d. Color: Black.
    - e. Orientation: Vertical.
  - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
  - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. RTDs and Transmitters:
  - 1. Accuracy: Plus or minus 0.2 percent at calibration point.
  - 2. Wire: Twisted, shielded-pair cable.
  - 3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
  - 4. Averaging Elements in Ducts: 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
  - 5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
  - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
    - a. Set-Point Adjustment: Concealed.
    - b. Set-Point Indication: Exposed.
    - c. Thermometer: Concealed.
    - d. Color: Black.
    - e. Orientation: Vertical.
  - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
  - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- D. Pressure Transmitters/Transducers:
  - 1. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input, and temperature compensated.
    - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.

- b. Output: 4 to 20 mA.
- c. Building Static-Pressure Range: 0- to 0.25-inch wg.
- d. Duct Static-Pressure Range: 0- to 5-inch wg.
- 2. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
- 3. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.
- E. Carbon Dioxide (CO2) Sensors:
  - 1. Wall mounted or duct mounted as indicated, with suitable range for expected range.
    - a. Type: Non-Dispersive Infrared.
    - b. Light Tube Material: Gold-plated.
    - c. Output: 0 to 10 V and 4 to 20 mA.
    - d. Long Term Stability: <5.0% of full scale after five years.
    - e. Response Time: 1 minute.
    - f. Humidity Range: 0 to 85% relative humidity, noncondensing.
    - g. Operating Temperature Range: 23°F to 113°F.
    - h. Storage Temperature Range: -4°F to 158°F.
    - i. Resolution of Analog Outputs: 2.5 ppm CO2.
- F. Room Sensor Cover Construction: Manufacturer's standard locking covers.
  - 1. Set-Point Adjustment: Concealed.
  - 2. Set-Point Indication: Exposed.
  - 3. Thermometer: Concealed.
  - 4. Color: Black.
  - 5. Orientation: Vertical.
- G. Room sensor accessories include the following:
  - 1. Insulating Bases: For sensors located on exterior walls.
  - 2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
  - 3. Adjusting Key: As required for calibration and cover screws.

# 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. Air-handling units specified in Division 23 Section "Packaged, Rooftop Heating and Ventilating Units."
    - b. Roof-top units specified in Division 23 Section "Indoor Central-Station Air Handling Units."
    - c. Variable-frequency controllers specified in Division 23 Section "Variable-Frequency Motor Controllers."
    - d. Ceiling fan controllers specified in Division 23 Section "HVAC Power Ventilators."
- B. Communication Interface to Other Building Systems:
  - 1. DDC system shall have a communication interface with systems having a communication interface.
  - 2. Systems to Be Connected:
    - a. Existing EMCS.

# 3.3 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 duct fabricator and Installer for installation in ductwork. Include installation instructions to Installer and supervise installation for compliance with requirements.
  - 1. DDC control dampers, which are specified in Section 230923.12 "DDC Control Dampers."
  - 2. Pressure sensors.

- C. 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.
  - 2. Pipe-mounted sensors, switches and transmitters.
  - 3. Pipe- and tank-mounted thermowells.

# 3.4 CONTROL DEVICES FOR EQUIPMENT MANUFACTURER FACTORY INSTALLATION

- A. Deliver the following to terminal unit manufacturer for factory installation. Include installation instructions to terminal unit manufacturer.
  - 1. Application-specific controller.
  - 2. Electric damper actuator.
  - 3. Unit-mounted flow and pressure sensors, transmitters and transducers.
  - 4. Unit-mounted temperature sensorsRelays.

# 3.5 GENERAL INSTALLATION REQUIREMENTS

- A. Furnish and install variable frequency controllers for hydronic pump according to Division 23 Section "Variable Frequency Motor Controllers."
- B. Install products to satisfy more stringent of all requirements indicated.
- C. Install products level, plumb, parallel, and perpendicular with building construction.
- 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. Welding Requirements:
  - 1. Restrict welding and burning to supports and bracing.
  - 2. No equipment shall be cut or welded without approval. Welding or cutting will not be approved if there is risk of damage to adjacent Work.
  - 3. Welding, where approved, shall be by inert-gas electric arc process and shall be performed by qualified welders according to applicable welding codes.
  - 4. If requested on-site, show satisfactory evidence of welder certificates indicating ability to perform welding work intended.

- I. 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.
- J. 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.
- K. Corrosive Environments:
  - 1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:
    - a. Laboratory exhaust-air streams.
    - b. Process exhaust-air streams.
  - 2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
  - 3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

## 3.6 OPERATOR WORKSTATION INSTALLATION

- A. Portable Operator Workstations Installation:
  - 1. Turn over portable operator workstations to Owner at Substantial Completion.
  - 2. Install software on workstation(s) and verify software functions properly.
- B. Color Graphics Application:
  - 1. Use system schematics indicated as starting point to create graphics.
  - 2. Develop Project-specific library of symbols for representing system equipment and products.
  - 3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
  - 4. Submit sketch of graphic layout with description of all text for each graphic for Owner's review before creating graphic using graphics software.
  - 5. Seek Owner input in graphics development once using graphics software.
  - 6. Final editing shall be done on-site with Owner's and Architect's review and feedback.
  - 7. Refine graphics as necessary for Owner acceptance.

8. On receiving Owner acceptance, print a hard copy for inclusion in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of DDC system operation and maintenance manual.

# 3.7 POT INSTALLATION

- A. Install one portable operator terminal(s).
- B. Turn over POTs to Owner at Substantial Completion.
- C. Install software on each POT and verify that software functions properly.

#### 3.8 GATEWAY INSTALLATION

- A. Install gateways if required for DDC system communication interface requirements indicated.
  - 1. Install gateway(s) required to suit indicated requirements.
- B. Test gateway to verify that communication interface functions properly.

## 3.9 CONTROLLER INSTALLATION

- A. Install controllers in enclosures to comply with indicated requirements.
- B. Connect controllers to field power supply.
- C. Install controller with latest version of applicable software and configure to execute requirements indicated.
- D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.
- E. Installation of Network Controllers:
  - 1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  - 2. Install controllers in a protected location that is easily accessible by operators.
  - 3. Top of controller shall be within 72 inches of finished floor.
- F. Installation of Programmable Application Controllers:
  - 1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  - 2. Install controllers in a protected location that is easily accessible by operators.
  - 3. Top of controller shall be within 72 inches of finished floor.
- G. Application-Specific Controllers:

- 1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
- 2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

## 3.10 ENCLOSURES INSTALLATION

- A. Install the following items in enclosures, to comply with indicated requirements:
  - 1. Gateways.
  - 2. Routers.
  - 3. Controllers.
  - 4. Electrical power devices.
  - 5. UPS units.
  - 6. Relays.
  - 7. Accessories.
  - 8. Instruments.
  - 9. Actuators
- B. Attach wall-mounted enclosures to wall using the following types of steel struts:
  - 1. For NEMA 250, Type 1 Enclosures: Use corrosion-resistant-coated steel strut and hardware.
  - 2. For NEMA 250, Type 4X Enclosures and Enclosures Located Outdoors: Use stainlesssteel strut and hardware.
  - 3. Install plastic caps on exposed cut edges of strut.
- C. Align top or bottom of adjacent enclosures of like size.
- D. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

#### 3.11 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 Division 26 Section "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.
- D. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.

E. Comply with requirements in Division 26 Section "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

#### 3.12 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Division 26 Section "Identification for Electrical Systems" for identification products and installation.
- B. Install engraved phenolic nameplate with unique identification on face for each of the following:
  - 1. Operator workstation.
  - 2. Gateway.
  - 3. DDC controller.
  - 4. Enclosure.
  - 5. Electrical power device.
  - 6. Accessory.
- C. Install engraved phenolic nameplate with unique instrument identification on face of each instrument connected to a DDC controller.
- D. Install engraved phenolic nameplate with identification on face of each control damper and valve actuator connected to a DDC controller.
- E. Where product is installed above accessible tile ceiling, also install matching engraved phenolic nameplate with identification on face of ceiling grid located directly below.
- F. Where product is installed above an inaccessible ceiling, also install engraved phenolic nameplate with identification on face of access door directly below.
- G. Warning Labels:
  - 1. Shall be permanently attached to equipment that can be automatically started by DDC control system.
  - 2. Shall be located in highly visible location near power service entry points.

#### 3.13 NETWORK INSTALLATION

- A. Install copper cable when connecting between the following network devices:
  - 1. Operator workstations.
  - 2. Operator workstations and network controllers.
  - 3. Network controllers.
- B. Install copper cable when connecting between the following:
  - 1. Gateways.
- 2. Gateways and network controllers or programmable application controllers.
- 3. Routers.
- 4. Routers and network controllers or programmable application controllers.
- 5. Network controllers and programmable application controllers.
- 6. Programmable application controllers.
- 7. Programmable application controllers and application-specific controllers.
- 8. Application-specific controllers.
- C. Install network cable in continuous raceway.
  - 1. Where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

# 3.14 NETWORK NAMING AND NUMBERING

- A. Coordinate with Owner and provide unique naming and addressing for networks and devices.
- B. ASHRAE 135 Networks:
  - 1. MAC Address:
    - a. Every network device shall have an assigned and documented MAC address unique to its network.
    - b. Ethernet Networks: Document MAC address assigned at its creation.
    - c. ARCNET or MS/TP networks: Assign from 00 to 64.
  - 2. Network Numbering:
    - a. Assign unique numbers to each new network.
    - b. Provide ability for changing network number through device switches or operator interface.
    - c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.
  - 3. Device Object Identifier Property Number:
    - a. Assign unique device object identifier property numbers or device instances for each device network.
    - b. Provide for future modification of device instance number by device switches or operator interface.
    - c. LAN shall support up to 4,194,302 unique devices.
  - 4. Device Object Name Property Text:
    - a. Device object name property field shall support 32 minimum printable characters.
    - b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.

- 1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."
- 2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102".
- 5. Object Name Property Text for Other Than Device Objects:
  - a. Object name property field shall support 32 minimum printable characters.
  - b. Assign object name properties with plain-English names descriptive of application.
    - 1) Example 1: "Zone 1 Temperature."
    - 2) Example 2 "Fan Start and Stop."
- 6. Object Identifier Property Number for Other Than Device Objects:
  - a. Assign object identifier property numbers according to tables indicated.
  - b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

## 3.15 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 Division 26 Section "Cable Trays for Electrical Systems."
  - 3. Comply with requirements for raceways and boxes specified in Division 26 Section "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.
- 10. Direct bury conduits underground or install in concrete-encased duct bank where indicated.
  - a. Use rigid, nonmetallic, Schedule 80 PVC.
  - b. Provide a burial depth according to NFPA 70, but not less than 24 inches.
- 11. Secure threaded conduit entering an instrument enclosure, cabinet, box, and trough, with a locknut on outside and inside, such that conduit system is electrically continuous throughout. Provide a metal bushing on inside with insulated throats. Locknuts shall be the type designed to bite into the metal or, on inside of enclosure, shall have a grounding wedge lug under locknut.
- 12. Conduit box-type connectors for conduit entering enclosures shall have an insulated throat.
- 13. Connect conduit entering enclosures in wet locations with box-type connectors or with watertight sealing locknuts or other fittings.
- 14. Offset conduits where entering surface-mounted equipment.
- 15. Seal conduit runs used by sealing fittings to prevent the circulation of air for the following:
  - a. Conduit extending from interior to exterior of building.
  - b. Conduit extending into pressurized duct and equipment.
  - c. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
- 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.
- 21. Protection from Electro-Magnetic Interference (EMI): Provide installation free of (EMI). As a minimum, comply with the following requirements:
  - 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.

- 3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 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.
  - 3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 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) Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
- e. Separation between Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
- f. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

#### 3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 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.
  - 3. Testing of Pneumatic and Air-Signal Tubing:
    - a. Test for leaks and obstructions.
    - b. After foreign matter is expelled and line is free from obstructions, plug far end of tubing run.
    - c. Connect a pressure source to near end of run with a needle valve between air supply and tubing run.
    - d. Connect a pressure gage accurate to within 0.5 percent of test between the shutoff needle valve and tubing run under test.
    - e. For system pressures above 30 psig, apply a pressure of 1.5 times operating pressure. Record pressure in tubing run every 10 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 1 psig.
    - f. For system pressures 30 psig and below, apply a pressure of 2.0 times operating pressure to piping and tubing run. Record pressure in tubing run every 5 minutes

for one hour. Allowable drop in pressure in one-hour period shall not exceed 0.5 psig.

- D. Testing:
  - 1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.
  - 2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.
  - 3. 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.
  - 4. 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.
  - 5. Test Equipment: Use a fiber-optic time domain reflectometer for testing of length and optical connectivity.
  - 6. Test Results: Record test results and submit copy of test results for Project record.

# 3.17 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. For pneumatic products, verify that air supply for each product is properly installed.
- F. Control Damper Checkout:
  - 1. Verify that control dampers are installed correctly for flow direction.
  - 2. Verify that proper blade alignment, either parallel or opposed, has been provided.
  - 3. Verify that damper frame attachment is properly secured and sealed.
  - 4. Verify that damper actuator and linkage attachment is secure.
  - 5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
  - 6. Verify that damper blade travel is unobstructed.
- G. Control Valve Checkout:

- 1. For pneumatic valves, verify that pressure gages are provided in each air line to valve actuator and positioner.
- 2. Verify that control valves are installed correctly for flow direction.
- 3. Verify that valve body attachment is properly secured and sealed.
- 4. Verify that valve actuator and linkage attachment is secure.
- 5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
- 6. Verify that valve ball, disc or plug travel is unobstructed.
- 7. 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.
- H. 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.

# 3.18 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. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.

- G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
- H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
- I. 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.
- J. 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.
- K. Digital Signals:
  - 1. Check digital signals using a jumper wire.
  - 2. Check digital signals using an ohmmeter to test for contact making or breaking.
- L. Control Dampers:
  - 1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
  - 2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
  - 3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
  - 4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
- M. 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.
- N. Meters: Check sensors at zero, 50, and 100 percent of Project design values.
- O. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

- P. Switches: Calibrate switches to make or break contact at set points indicated.
- Q. 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.

### 3.19 DDC SYSTEM CONTROLLER CHECKOUT

- A. Verify power supply.
  - 1. Verify voltage, phase and hertz.
  - 2. Verify that protection from power surges is installed and functioning.
  - 3. Verify that ground fault protection is installed.
  - 4. If applicable, verify if connected to UPS unit.
  - 5. If applicable, verify if connected to a backup power source.
  - 6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.
- B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.
- C. Verify that spare I/O capacity is provided.

## 3.20 DDC CONTROLLER I/O CONTROL LOOP TESTS

- A. Testing:
  - 1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
  - 2. Test every I/O point throughout its full operating range.
  - 3. Test every control loop to verify operation is stable and accurate.
  - 4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
  - 5. Test and adjust every control loop for proper operation according to sequence of operation.
  - 6. Test software and hardware interlocks for proper operation. Correct deficiencies.
  - 7. Operate each analog point at the following:
    - a. Upper quarter of range.
    - b. Lower quarter of range.
    - c. At midpoint of range.
  - 8. Exercise each binary point.

- 9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
- 10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

# 3.21 DDC SYSTEM VALIDATION TESTS

- A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.
- B. After approval of Test Plan, execute all tests and procedures indicated in plan.
- C. After testing is complete, submit completed test checklist.
- D. Pretest Checklist: Submit the following list with items checked off once verified:
  - 1. Detailed explanation for any items that are not completed or verified.
  - 2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
  - 3. HVAC equipment motors operate below full-load amperage ratings.
  - 4. Required DDC system components, wiring, and accessories are installed.
  - 5. Installed DDC system architecture matches approved Drawings.
  - 6. Control electric power circuits operate at proper voltage and are free from faults.
  - 7. Required surge protection is installed.
  - 8. DDC system network communications function properly, including uploading and downloading programming changes.
  - 9. Using BACnet protocol analyzer, verify that communications are error free.
  - 10. Each controller's programming is backed up.
  - 11. Equipment, products, tubing, wiring cable and conduits are properly labeled.
  - 12. All I/O points are programmed into controllers.
  - 13. Testing, adjusting and balancing work affecting controls is complete.
  - 14. Dampers and actuators zero and span adjustments are set properly.
  - 15. Each control damper and actuator goes to failed position on loss of power.
  - 16. Valves and actuators zero and span adjustments are set properly.
  - 17. Each control valve and actuator goes to failed position on loss of power.
  - 18. Meter, sensor and transmitter readings are accurate and calibrated.
  - 19. Control loops are tuned for smooth and stable operation.
  - 20. View trend data where applicable.
  - 21. Each controller works properly in standalone mode.
  - 22. Safety controls and devices function properly.
  - 23. Interfaces with fire-alarm system function properly.
  - 24. Electrical interlocks function properly.
  - 25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
  - 26. Record Drawings are completed.
- E. Test Plan:

- 1. Prepare and submit a validation test plan including test procedures for performance validation tests.
- 2. Test plan shall address all specified functions of DDC system and sequences of operation.
- 3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
- 4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
- 5. Include a test checklist to be used to check and initial that each test has been successfully completed.
- 6. Submit test plan documentation 20 business days before start of tests.
- F. Validation Test:
  - 1. Verify operating performance of each I/O point in DDC system.
    - a. Verify analog I/O points at operating value.
    - b. Make adjustments to out-of-tolerance I/O points.
      - 1) Identify I/O points for future reference.
      - 2) Simulate abnormal conditions to demonstrate proper function of safety devices.
      - 3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.
  - 2. Simulate conditions to demonstrate proper sequence of control.
  - 3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
  - 4. After 24 Hours following Initial Validation Test:
    - a. Re-check I/O points that required corrections during initial test.
    - b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.
  - 5. After 24 Hours of Second Validation Test:
    - a. Re-check I/O points that required corrections during second test.
    - b. Continue validation testing until I/O point is normal on two consecutive tests.
  - 6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.
  - 7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.
- G. DDC System Response Time Test:
  - 1. Simulate HLC.
    - a. Heavy load shall be an occurrence of 50 percent of total connected binary COV, one-half of which represent an "alarm" condition, and 50 percent of total

connected analog COV, one-half of which represent an "alarm" condition, that are initiated simultaneously on a one-time basis.

- 2. Initiate 10 successive occurrences of HLC and measure response time to typical alarms and status changes.
- 3. Measure with a timer having at least 0.1-second resolution and 0.01 percent accuracy.
- 4. Purpose of test is to demonstrate DDC system, as follows:
  - a. Reaction to COV and alarm conditions during HLC.
  - b. Ability to update DDC system database during HLC.
- 5. Passing test is contingent on the following:
  - a. All alarms, both binary and analog, are reported and printed; none are lost.
  - b. Compliance with response times specified.
- 6. Prepare and submit a report documenting HLC tested and results of test including time stamp and print out of all alarms.
- H. DDC System Network Bandwidth Test:
  - 1. Test network bandwidth usage on all DDC system networks to demonstrate bandwidth usage under DDC system normal operating conditions and under simulated HLC.
  - 2. To pass, none of DDC system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

#### 3.22 FINAL REVIEW

- A. Submit written request to Architect when DDC system is ready for final review. Written request shall state the following:
  - 1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
  - 2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
  - 3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
  - 4. DDC system is complete and ready for final review.
- B. Review by Architect shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.
- C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.
- D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third

and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.

- E. Prepare and submit closeout submittals when no deficiencies are reported.
- F. A part of DDC system final review shall include a demonstration to parties participating in final review.
  - 1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
  - 2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
  - 3. Demonstration shall include, but not be limited to, the following:
    - a. Accuracy and calibration of 10 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
    - b. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.
    - c. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.
    - d. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
    - e. Trends, summaries, logs and reports set-up for Project.
    - f. For up to three HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.
    - g. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.
    - h. Software's ability to edit control programs off-line.
    - i. Data entry to show Project-specific customizing capability including parameter changes.
    - j. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
    - k. Execution of digital and analog commands in graphic mode.
    - 1. Spreadsheet and curve plot software and its integration with database.
    - m. Online user guide and help functions.
    - n. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.
    - o. System speed of response compared to requirements indicated.
    - p. For Each Network Controller:
      - 1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.

- 2) Operator Interface: Ability to connect directly to each type of digital controller with a portable operator workstation and PDA. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.
- 3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
- 4) Electric Power: Ability to disconnect any controller safely from its power source.
- 5) Wiring Labels: Match control drawings.
- 6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.
- 7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.
- q. For Each Operator Workstation:
  - 1) I/O points lists agree with naming conventions.
  - 2) Graphics are complete.
  - 3) UPS unit, if applicable, operates.
- r. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Use ASHRAE 135 protocol analyzer to help identify devices, view network traffic, and verify interoperability. Requirements must be met even if only one manufacturer's equipment is installed.
  - 1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
  - 2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
  - 3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated.
  - 4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
  - 5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
  - 6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
  - 7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
  - 8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
  - 9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.

- 10) Device and Network Management:
  - a) Display of network device status.
  - b) Display of BACnet Object Information.
  - c) Silencing devices transmitting erroneous data.
  - d) Time synchronization.
  - e) Remote device re-initialization.
  - f) Backup and restore network device programming and master database(s).
  - g) Configuration management of routers.

### 3.23 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to four visits to Project during other-than-normal occupancy hours for this purpose.

### 3.24 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by DDC system manufacturer's authorized service representative. Include semiannual preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### 3.25 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two year(s).
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two year(s) from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access system and to upgrade computer equipment if necessary.

#### 3.26 DEMONSTRATION

- A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.
- B. Extent of Training:

- 1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
- 2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
- 3. Minimum Training Requirements:
  - a. Provide not less than one day of training total.
- C. Training Schedule:
  - 1. Schedule training with Owner 20 business days before expected Substantial Completion.
  - 2. Schedule training to provide Owner with at least 10 business days of notice in advance of training.
  - 3. Provide staggered training schedule as requested by Owner.
- D. Training Attendee List and Sign-in Sheet:
  - 1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
  - 2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
  - 3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
  - 4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
  - 5. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

END OF SECTION 230900

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. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
  - 1. Hot-water heating piping.
  - 2. Condensate-drain piping.
  - 3. Air-vent piping.
  - 4. Safety-valve-inlet and -outlet piping.
  - 5. Seismic joints.
- B. Related Sections include the following:
  - 1. Section 230523.12 "Ball Valves for HVAC Piping" for ball valves.
  - 2. Section 230523.13 "Butterfly Valves for HVAC Piping" for butterfly valves.
  - 3. Section 230523.14 "Check Valves for HVAC Piping" for check valves
  - 4. Section 232123 "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping

### 1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.
- B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

## 1.4 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.
- B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of

the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops. Show coordination with work of other trades.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Field quality-control test reports.
- D. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

### 1.6 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.

### 1.7 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.

### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

## PART 2 - PRODUCTS

### 2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
- E. Grooved fittings: Not allowed.
- F. Copper or Bronze Pressure-Seal Fittings: Not allowed.
- G. Copper, Mechanically Formed Tee Option: Not allowed.
- H. Wrought-Copper Unions: ASME B16.22.

#### 2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
- E. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - 1. Material Group: 1.1.
  - 2. End Connections: Butt welding.
  - 3. Facings: Raised face.
- G. Grooved Mechanical-Joint Fittings and Couplings: Not allowed
- H. Steel Pressure-Seal Fittings: Not allowed.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

## 2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

## 2.4 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 Unions:
  - 1. Description:
    - a. Standard: ASSE 1079.
    - b. Pressure Rating: 150.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  - 1. Description:
    - a. Standard: ASSE 1079.
    - b. Factory-fabricated, bolted, companion-flange assembly.
    - c. Pressure Rating: 150 psig.
    - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solderjoint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
  - 1. Description:
    - a. Nonconducting materials for field assembly of companion flanges.

- b. Pressure Rating: 150 psig.
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
  - 1. Description:
    - a. Standard: IAPMO PS 66
    - 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.

# 2.5 VALVES

- A. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Instrumentation and Control for HVAC."
- B. 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. Griswold Controls.
    - e. Approved equal.
  - 2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
  - 3. Ball: Brass or stainless steel.
  - 4. Stem Seals: EPDM O-rings.
  - 5. Disc: Glass and carbon-filled PTFE.
  - 6. Seat: PTFE.
  - 7. End Connections: Flanged.
  - 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
  - 9. Handle Style: Lever, with memory stop to retain set position.
  - 10. CWP Rating: Minimum 125 psig.
  - 11. Maximum Operating Temperature: 250 deg F.

# 2.6 AIR CONTROL DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amtrol, Inc.
  - 2. Armstrong Pumps, Inc.

- 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
- 4. Spirotherm
- 5. Approved equal.
- B. Manual Air Vents:
  - 1. Body: Bronze.
  - 2. Internal Parts: Nonferrous.
  - 3. Operator: Screwdriver or thumbscrew.
  - 4. Inlet Connection: NPS 1/2 (DN 15).
  - 5. Discharge Connection: NPS 1/8 (DN 6).
  - 6. CWP Rating: 150 psig (1035 kPa).
  - 7. Maximum Operating Temperature: 225 deg F (107 deg C).
- C. Automatic Air Vents:
  - 1. Body: Bronze or cast iron.
  - 2. Internal Parts: Nonferrous.
  - 3. Operator: Noncorrosive metal float.
  - 4. Inlet Connection: NPS 1/2.
  - 5. Discharge Connection: NPS 1/4.
  - 6. CWP Rating: 150 psig.
  - 7. Maximum Operating Temperature: 240 deg F.

## 2.7 AUTOMATIC FLOW CONTROL VALVES:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. FlowCon International
  - 2. Flow Design Inc.
  - 3. Griswold Controls.
- B. Body: Brass or ferrous metal.
- C. Piston and Spring Assembly: Corrosion resistant, tamper proof, self cleaning, and removable.
- D. Combination Assemblies: Include bonze or brass-alloy ball valve.
- E. Identification Tag: Marked with zone identification, valve number, and flow rate.
- F. Size: Same as pipe in which installed.
  - 1. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
  - 2. Minimum CWP Rating: 175 psig.
  - 3. Maximum Operating Temperature: 200 deg F

# 2.8 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

#### HYDRONIC PIPING

- 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
- 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
- 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
- 4. CWP Rating: 125 psig.
- B. Basket Strainers:
  - 1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
  - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
  - 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  - 4. CWP Rating: 125 psig.

# 2.9 SEISMIC JOINT

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Metraflex
- B. Seismic Rating: Required.
- C. Construction: Two flexible sections of hose and braid, two 45° elbows and a 90° return. Factory supplied center support, drain/air releas plug.
- D. Minimum movement: 3" +/- in X, Y and Z planes.

## PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller shall be any of the following:
  - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
  - 2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger shall be any of the following:
  - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
  - 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Makeup-water piping installed aboveground shall be the following:

- 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- D. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- E. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- F. Air-Vent Piping:
  - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
  - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- G. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

## 3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves 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 at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

#### 3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, inline pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Section 230516 "Expansion Fittings and Loops for HVAC Piping."
- U. Identify piping as specified in Section 230553 "Identification for HVAC Piping and Equipment."

- V. 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 Pipin."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

## 3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
  - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
  - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
  - 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
  - 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
  - 8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch
- E. 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 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 4. NPS 2: Maximum span, 8 feet ; minimum rod size, 3/8 inch.
  - 5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  - 6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

### 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.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

#### 3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- C. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- D. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.
- E. Install flex connection at each pump inlet and outlet and as indicated.

# 3.7 SEISMIC JOINT INSTALLATION

- A. Install per manufacturer's recommendations.
- B. Support return bend to allow 100% of the loops indicated movement.

# HYDRONIC PIPING

### 3.8 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 bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 230519 "Meters and Gages for HVAC Piping."

### 3.9 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
  - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  - 3. Isolate expansion tanks and determine that hydronic system is full of water.
  - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  - 6. Prepare written report of testing.
- C. Perform the following before operating the system:

- 1. Open manual valves fully.
- 2. Inspect pumps for proper rotation.
- 3. Set makeup pressure-reducing valves for required system pressure.
- 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
- 5. Set temperature controls so all coils are calling for full flow.
- 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, to specified values.
- 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

# SECTION 232113.13 - UNDERGROUND HYDRONIC PIPING

# PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Cased piping system.

## 1.2 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing hydronic piping systems with the following minimum working-pressure ratings:
  - 1. Hot-Water Piping: 150 psig at 200 deg F.

# 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Cased piping.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content and chemical components.
- C. Shop Drawings: For underground hydronic piping. Signed and sealed by a professional engineer.
  - 1. Calculate requirements for expansion compensation for underground piping.
  - 2. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads, and show concrete thrust block dimensions.
  - 3. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For cased piping.
- B. Source quality-control reports.
- C. Field quality-control reports.

#### UNDERGROUND HYDRONIC PIPING

# 1.5 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

# PART 2 - PRODUCTS

## 2.1 CASED PIPING SYSTEM

- A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Perma-Pipe, Inc.
    - b. Rovanco Piping Systems, Inc.
    - c. Thermacor Process, LP
- B. Carrier Pipe: Schedule 40, steel pipe and fittings.
- C. Carrier Pipe Insulation:
  - 1. Polyurethane Foam Pipe Insulation: Rigid, cellular, high-pressure injected between carrier pipe and jacket.
    - a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed 0.14 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
- D. Casing: HDPE, conforming to ASTM D1248 and D3350. 150 mils minimum thickness.
- E. Casing accessories include the following:
  - 1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
  - 2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
  - 3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.
- F. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

## PART 3 - EXECUTION

## 3.1 EARTHWORK

A. See Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATION

- A. Hot-Water Heating Piping:
  - 1. NPS 6 and smaller:
    - a. Cased piping with polyurethane carrier-pipe insulation.
      1) Piping Insulation Thickness: 2 inches.
    - b. Schedule 40 steel pipe; Class 150, malleable-iron fittings; welded joints.

#### 3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Remove standing water in the bottom of trench.
- C. Do not backfill piping trench until field quality-control testing has been completed and results approved.
- D. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.
- E. In conduits, install drain valves at low points and manual air vents at high points.
- F. Install components with pressure rating equal to or greater than system operating pressure.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. See Section 230517 "Sleeves and Sleeve Seals for HVAC Piping" for sleeves and mechanical sleeve seals through exterior building walls.
- J. Secure anchors with concrete thrust blocks. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

#### 3.4 JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- D. Welded Joints: Construct joints according to AWS D10.12M/D10.12.
- E. Conduit and Cased Piping Joints: Assemble sections and finish joints with pourable or split insulation and exterior jacket sleeve, and apply shrink-wrap seals.

#### 3.5 IDENTIFICATION

A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes 6 to 8 inches below finished grade, directly over piping. See Section 312000 "Earth Moving" for warning-tape materials and devices and their installation.

# 3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Prepare hydronic piping for testing according to ASME B31.9 and as follows:
    - a. Leave joints, including welds, uninsulated and exposed for examination during test.
    - b. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
    - c. Use vents installed at high points to release trapped air while filling system.
  - 2. Test hydronic piping as follows:
    - a. Subject hydronic piping to hydrostatic test pressure that is not less than 1.5 times the design pressure.
    - b. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.
- B. Prepare test and inspection reports.

END OF SECTION 232113.13

SECTION 232123 - HYDRONIC PUMPS

# PART 1 - GENERAL

# 1.1 SUMMARY

- A. Section Includes:
  - 1. Close-coupled, in-line centrifugal pumps.

# 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of pump.
- B. Shop Drawings: For each pump.
  - 1. Show pump layout and connections.
  - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
  - 3. Include diagrams for power, signal, and control wiring.

# 1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

## PART 2 - PRODUCTS

## 2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS – (P-1)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong Pumps, Inc.
  - 2. ITT Corporation.
  - 3. PACO Pumps; Grundfos Pumps Corporation, USA.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, inline pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
- C. Pump Construction:
  - 1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet and threaded companion-flange connections.

- 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
- 3. Pump Shaft: Stainless steel.
- 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
- 5. Pump Bearings: Oil lubricated; bronze-journal or thrust type.
- D. Motor: Single speed and rigidly mounted to pump casing.
  - 1. 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. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - a. Enclosure: Totally enclosed, fan cooled.
    - b. Enclosure Materials: Rolled steel.
    - c. Motor Bearings: Permanently lubricated ball bearings.
    - d. Efficiency: Premium efficient.
- E. Capacities and Characteristics: As indicated. a.

# 2.2 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser:
  - 1. Angle pattern.
  - 2. 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
  - 3. Bronze startup and bronze or stainless-steel permanent strainers.
  - 4. Bronze or stainless-steel straightening vanes.
  - 5. Drain plug.
  - 6. Factory-fabricated support.
- B. Triple-Duty Valve:
  - 1. Angle or straight pattern.
  - 2. 175-psig pressure rating, cast-iron body, pump-discharge fitting.
  - 3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
  - 4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

### 3.1 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
  - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.
  - 1. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
  - 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

### 3.2 ALIGNMENT

- A. Engage a factory-authorized service representative to perform alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

## 3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install triple-duty valve on discharge side of pumps.
- F. Install suction diffuser and shutoff valve on suction side of pumps.
- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- I. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 232123

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Rectangular ducts and fittings.
  - 2. Round ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Sealant and gaskets.
  - 5. Hangers and supports.
  - 6. Seismic-restraint devices.
- 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, ductmounting access doors and panels, turning vanes, and flexible ducts.

## 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards Metal and Flexible" and ASCE/SEI 7.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. IEQ Submittals:
  - 1. Product Data: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 "Systems and Equipment."
  - 2. Product Data: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 "HVAC System Construction and Insulation."

- 3. Duct-Cleaning Test Report: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 "Ventilation System Start-up."
- 4. Product: For adhesives and sealants, documentation including printed statement of VOC content.
- 5. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  - 2. Suspended ceiling components.
  - 3. Structural members to which duct will be attached.
  - 4. Size and location of initial access modules for acoustical tile.
  - 5. Penetrations of smoke barriers and fire-rated construction.
  - 6. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
  - 7. Perimeter moldings
- D. Shop Drawings:
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory- and shop-fabricated ducts and fittings.
  - 3. Duct layout indicating sizes, configuration, and static-pressure classes.
  - 4. Elevation of top of ducts.
  - 5. Dimensions of main duct runs from building grid lines.
  - 6. Fittings.
  - 7. Reinforcement and spacing.
  - 8. Seam and joint construction.
  - 9. Penetrations through fire-rated and other partitions.
  - 10. Equipment installation based on equipment being used on Project.
  - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  - 12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- E. 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.
- 5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  - 2. Suspended ceiling components.
  - 3. Structural members to which duct will be attached.
  - 4. Size and location of initial access modules for acoustical tile.
  - 5. Penetrations of smoke barriers and fire-rated construction.
  - 6. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Perimeter moldings.
- B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel," for hangers and supports.
  - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum," for aluminum supports.
  - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
  - 4. Washington Association Building Officials
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

### PART 2 - PRODUCTS

#### 2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 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."
- E. Pressure ratings: As indicated.

#### 2.2 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.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-1, "Round 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."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-2, "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."
  - 1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "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.
  - 1. Galvanized Coating Designation: [G60] [G90].
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. 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.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

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## 2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Tape Width: [3 inches] [4 inches] [6 inches].
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 7. Service: Indoor and outdoor.
  - 8. Service Temperature: Minus 40 to plus 200 deg F.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  - 10. 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).
  - 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
  - 1. General: Single-component, acid-curing, silicone, elastomeric.
  - 2. Type: S.
  - 3. Grade: NS.
  - 4. Class: 25.
  - 5. Use: O.
  - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

## 2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

# 2.6 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. B-line, an Eaton business.
  - 2. Kinetics Noise Control, Inc.
  - 3. Mason Industries, Inc.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
  - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

# 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. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. 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 SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.
- B. 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."
- C. Supply Ducts:
  - 1. Ducts Connected downstream of Terminal Units (VAV-X):
    - a. Pressure Class: Positive 1-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
  - 2. Ducts Located Inside and Connected to Variable-Air-Volume Air-Handling Units:
    - a. Pressure Class: Positive 4-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.

- d. SMACNA Leakage Class for Round and Flat Oval: 6.
- 3. Ducts Located Outside and Connected to Variable-Air-Volume Air-Handling Units:
  - a. Pressure Class: Positive 4-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 3.
  - d. SMACNA Leakage Class for Round and Flat Oval: 3
- 4. Ducts Connected to Equipment Not Listed Above:
  - a. Pressure Class: Positive 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 6.
- D. Return Ducts:
  - 1. Ducts Located Outside and Connected to Air-Handling Units:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 3.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
  - 2. Ducts Located Outside and Connected to Air-Handling Units:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6
  - 3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: a.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6
- E. Exhaust Ducts:
  - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.

- 2. Ducts Connected to Type I and Tyype II Commercial Kitchen Hoods: Comply with NFPA 96.
  - a. Exposed to View: Type 304, stainless-steel sheet, No. 3 finish.
  - b. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
  - c. Welded seams and joints.
  - d. Pressure Class: Positive or negative 3-inch wg.
  - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
  - f. SMACNA Leakage Class: 3.

# 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.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 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 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." ASCE/SEI 7.
  - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.

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- 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

#### 3.6 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.

#### 3.7 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
  - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
  - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
  - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
  - 6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

## 3.8 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
- B. Intermediate Reinforcement:
  - 1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
  - 2. Stainless-Steel Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Match duct material.
- C. Elbow Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Velocity 1000 fpm or Lower:
      - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      - 2) Mitered Type RE 4 without vanes.
    - b. Velocity 1000 to 1500 fpm:
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
    - c. Velocity 1500 fpm or Higher:
      - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 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."

- 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:
  - 1. Backdraft.
  - 2. Pressure relief access door
  - 3. Manual volume dampers.
  - 4. Control dampers.
  - 5. Fire dampers.
  - 6. Flange connectors.
  - 7. Turning vanes.
  - 8. Duct-mounted access doors.
  - 9. Flexible connectors.
  - 10. Flexible ducts.
  - 11. Duct accessory hardware.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
  - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.
    - c. Control damper installations.
    - d. Fire-damper installations, including sleeves; and duct-mounted access doors.
    - e. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and maintenance data.

### 1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

#### PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G60.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

### 2.2 BACKDRAFT DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Air Balance Inc.; a division of Mestek, Inc.
  - 2. Greenheck Fan Corporation.
  - 3. Nailor Industries Inc.
  - 4. Pottorff; a division of PCI Industries, Inc.
  - 5. Ruskin Company.
- B. Description: Gravity balanced.

- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 1-inch wg.
- E. Frame: 0.052-inch thick, galvanized sheet steel, with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
  - 1. Material: Nonferrous metal.
  - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum.
- 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.
  - 3. Electric actuators.
  - 4. Chain pulls.
  - 5. Front of rear screens.
  - 6. 90-degree stops.
- N. Sleeve: Minimum 20-gage thickness.

### 2.3 PRESSURE RELIEF ACCESS DOOR

- A. Pressure Relief Access Door:
  - 1. Door and Frame Material: Galvanized sheet steel.
  - 2. Door: Double wall with metal thickness applicable for duct pressure class.
  - 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
  - 4. Factory set to activate at a 0.5" higher than duct static pressure clarification.
  - 5. Doors close when pressures are within set-point range.
  - 6. Hinge: Continuous piano.
  - 7. Latches: Cam.
  - 8. Seal: Neoprene or foam rubber.
  - 9. Insulation Fill: 1-inch thick, fibrous-glass or polystyrene-foam board.

## ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON

### 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 available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. Flexmaster U.S.A., Inc.
    - c. METALAIRE, Inc.
    - d. Nailor Industries Inc.
    - e. Pottorff; a division of PCI Industries, Inc.
    - f. Ruskin Company.
    - g. Trox USA Inc.
    - h. Vent Products Company, Inc.
  - 2. Standard leakage rating, with linkage outside airstream.
  - 3. Suitable for horizontal or vertical applications.
  - 4. Frames:
    - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
    - 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.
  - 6. Blade Axles: Galvanized steel.
  - 7. Bearings:
    - a. Oil-impregnated bronze.
    - 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.
- B. Standard, Aluminum, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. Flexmaster U.S.A., Inc.
    - c. METALAIRE, Inc.

- d. Nailor Industries Inc.
- e. Pottorff; a division of PCI Industries, Inc.
- f. Ruskin Company.
- g. Trox USA Inc.
- 2. Standard leakage rating, with linkage outside airstream.
- 3. Suitable for horizontal or vertical applications.
- 4. Frames: Hat-shaped, 0.10-inch thick, aluminum sheet channels; frames with 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. Roll-Formed Aluminum Blades: 0.10-inch thick aluminum sheet.
  - e. Extruded-Aluminum Blades: 0.050-inch thick extruded aluminum.
- 6. Blade Axles: Galvanized steel.
- 7. Bearings:
  - a. Oil-impregnated bronze.
  - 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: Aluminum.
- C. Jackshaft:
  - 1. Size: 1-inch diameter.
  - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
  - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
  - 2. Include center hole to suit damper operating-rod size.
  - 3. Include elevated platform for insulated duct mounting.

### 2.5 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. Greenheck Fan Corporation.

- 3. Lloyd Industries, Inc.
- 4. METALAIRE, Inc.
- 5. Nailor Industries Inc.
- 6. Ruskin Company.

#### B. Frames:

- 1. Hat shaped.
- 2. Galvanized-steel channels, 0.064 inch thick.
- 3. Mitered and welded corners.
- C. Blades:
  - 1. Multiple blade with maximum blade width of 8 inches.
  - 2. Parallel- and opposed-blade design.
  - 3. Galvanized steel.
  - 4. 0.064 inch thick.
  - 5. Blade Edging: Closed-cell neoprene edging.
  - 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- D. Blade Axles: 1/2-inch diameter; galvanized steel blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
  - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- E. Bearings:
  - 1. Oil-impregnated bronze.
  - 2. 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.
  - 3. Thrust bearings at each end of every blade.

#### 2.6 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Air Balance Inc.; a division of Mestek, Inc.
  - 2. Greenheck Fan Corporation.
  - 3. METALAIRE, Inc.
  - 4. Nailor Industries Inc.
  - 5. Pottorff; a division of PCI Industries, Inc.
  - 6. Ruskin Company.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
  - 1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
  - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- K. Heat-Responsive Device: Electric resettable link and switch package, factory installed, 165 deg F rated.

#### 2.7 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Ductmate Industries, Inc.
  - 2. Nexus PDQ; Division of Shilco Holdings Inc.
  - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## 2.8 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1. Ductmate Industries, Inc.
- 2. Duro Dyne Inc.
- 3. METALAIRE, Inc.
- 4. SEMCO Incorporated.
- 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

### 2.9 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Cesco Products; a division of Mestek, Inc.
  - 2. Ductmate Industries, Inc.
  - 3. Flexmaster U.S.A., Inc.
  - 4. Greenheck Fan Corporation.
  - 5. Nailor Industries Inc.
  - 6. Pottorff; a division of PCI Industries, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," 7-3, "Access Panels - Round Duct," and 8-15 "Double Wall Duct Access Doors."
  - 1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  - 3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.

d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

## 2.10 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Ductmate Industries, Inc.
  - 2. Flame Gard, Inc.
  - 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

#### 2.11 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. Ventfabrics, Inc.
  - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd..
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.

- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
  - 1. Minimum Weight: 24 oz./sq. yd..
  - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
  - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

#### 2.12 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. McGill AirFlow LLC.
  - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helical ly wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  - 1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
  - 2. Maximum Air Velocity: 4000 fpm (20 m/s).
  - 3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
  - 4. Insulation R-Value: Comply with Washington State Energy Code.
- 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.

### 2.13 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.

### 2.14 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Pottorff.
  - 2. Ventfabrics, Inc.
  - 3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass or Aluminum.
- D. Cable: Stainless steel.
- E. Surface Mounting: Recessed.
- F. Surface Cover-Plate Material: Steel, painted to match adjacent surface.

### 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 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.
  - 3. Volume dampers not required between AHU discharge and VAV terminal units.
- D. Set dampers to fully open position before testing, adjusting, and balancing.

- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire dampers according to UL listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 2. Install pressure relief access door between air handling unit and first wall and/or floor penetration.
  - 3. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches
  - 5. Body Access: 25 by 14 inches.
  - 6. Body plus Ladder Access: 25 by 17 inches.
- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffer boots to low-pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
- P. Install duct test holes where required for testing and balancing purposes.
- Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.
- R. Install pressure relief access door between unit connection and first branch on supply and return for each air handling unit (AHU).

S. Install acoustic turning vanes in all supply, return, and exhaust system mitred elbows 45 degrees and larger and as indicated. Do not install turning vanes in commercial kitchen hood exhaust duct.

# 3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
  - 3. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation.
  - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Insulated flexible ducts.

# 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
  - 1. Product data showing compliance with ASHRAE 62.1.
  - 2. Product Data: For adhesives and sealants, indicating VOC content.
  - 3. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For flexible ducts.
  - 1. Include plans showing locations and mounting and attachment details.

## 1.3 INFORMATIONAL SUBMITTALS

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

## PART 2 - PRODUCTS

## 2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with 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.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

## 2.2 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. Flex-Tek Group.
  - 3. McGill AirFlow LLC.
- B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 210 deg F.
  - 4. Insulation R-Value: R6.

### 2.3 FLEXIBLE DUCT CONNECTORS

A. 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.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install flexible ducts 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 in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- E. Connect flexible ducts to metal ducts with draw bands.
- F. Install duct test holes where required for testing and balancing purposes.
- G. Installation:
  - 1. Install ducts fully extended.

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- 2. Do not bend ducts across sharp corners.
- 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
- 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
- 5. Install flexible ducts in a direct line, without sags, twists, or turns.
- H. Supporting Flexible Ducts:
  - 1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
  - 2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
  - 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
  - 4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 233346

# SECTION 233423 - HVAC POWER VENTILATORS

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Centrifugal roof ventilators.
  - 2. High Volume, Low Speed Ceiling fans.
  - 3. Ceiling mounted ventilators.

### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
  - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - 4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

# 1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

### 1.4 SPECIAL WARRANTIES

- A. High volume, low speed ceiling fans:
  - 1. Airfoil: Lifetime.
  - 2. Hub: Lifeetime.
  - 3. Motor: 15 years.
  - 4. Gearbox: 15 years.
  - 5. Controller: 15 years.
  - 6. All other fan components: 15 years.

# 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. High volume, low speed ceiling fans:
  - 1. Intertek/ETL certified, UL Stnadard 507, CSA Standard 22.2.

# PART 2 - PRODUCTS

## 2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acme Engineering & Manufacturing Corp.
  - 2. Greenheck Fan Corporation.
  - 3. Loren Cook Company.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
  - 1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Accessories:
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
  - 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  - 4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
- 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: 18 inches.
  - 3. Pitch Mounting: Manufacture curb for roof slope.
  - 4. Metal Liner: Galvanized steel.

F. Capacities and Characteristics: As indicated.

# 2.2 HIGH VOLUME, LOW SPEED CEILING FANS

- 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. Big Ass Fans.
- B. Onboard fan control: Variable frequency drive, pre-wired to motor, factory programmed to minimize starting and braking torques. Dedicated ground conductor..
- C. Airfoils: Eight airfoils, extruded aluminum alloy connected with two high strength lock bolts per airfoil.
- D. Motor: Totally enclosed, fan cooled with IP42 NEMA classification with NEMA 56C frame. Double baked Class F insulation, capable of continuous operation from -30°F to 122°F.
- E. Gearbox:
  - 1. Designed specifically for fan. High-efficiency, hermetically sealed, nitrogen filled, offset helical gear reducer with two stage gearing, hollow output shaft, cast iron housing, double lip seals, bearings with crowned cages.
  - 2. Hollow shaft threaded to accept a <sup>3</sup>/<sub>4</sub>"NPT fitting for routing of wiring to standard junction box affixed to shaft.
- F. Mounting post: Post to provide structural connection between fan assembly and extension tube, formed of A36 steel, without critical wlds, powder coated.
- G. Mounting system: ASTM A-36 steel mounting yoke, 3/16" thick, SAE Grade 8 or equivalent mounting bolts.
- H. Hub: Precision cut aluminum consisting of two aluminum plates, eight aluminum spars and one aluminum spacer.
- I. Safety Cable: 38/" diameter safety cable 7x19 galvanized steel cable, end loops secured with swaged sleeves, preloaded and tested to 3200 lbf. Field construction of safety cables not permitted.
- J. Wall control: Touchpad controls, LED display to control direction, operation, speed and programming. Cat 6 Ethernet cable between controller and fan. BACnet interface for connection to building control system.

## 2.3 CEILING MOUNTED VENTILATORS

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. Greenheck Fan Corporation.
- 2. Loren Cook Company.
- 3. PennBarry.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Stainless steel, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories:
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
  - 3. Isolation: Spring vibration isolators.
  - 4. Manufacturer's standard roof jack or wall cap, and transition fittings.
- G. Capacities and Characteristics As indicated.

#### 2.4 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.
- B. Enclosure Type: Totally enclosed, fan cooled, except as otherwise indicated.

## 2.5 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. 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. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
  - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
  - 3. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- 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."
- E. Suspend high volume, low velocity fans and controls in accordance with manufacturer's recommendations.

## 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.
  - 2. High Volume, Low Speed Ceiling Fans: Install by factory certified installer.
- 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 233600 - AIR TERMINAL UNITS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Shutoff, single-duct air terminal units.

# 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of air terminal unit.
- B. Sustainable Design Submittals:
  - 1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 "Systems and Equipment."
  - 2. Product Data: For adhesives, indicating VOC content.
  - 3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For air terminal units.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
  - 4. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- D. Delegated-Design Submittal:
  - 1. Materials, fabrication, assembly, and spacing of hangers and supports.
  - 2. Include design calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
- B. Field quality-control reports.

# 1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

# 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and System Start-up."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 Heating, Ventilating, and Air Conditioning."

## 2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Nailor Industries Inc.
  - 2. Titus.
  - 3. Trane.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.034-inch- thick galvanized steel, double wall.
  - 1. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  - 2. Air Outlet: S-slip and drive connections.
  - 3. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
  - 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
  - 1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 6-inch wg inlet static pressure.
  - 2. Damper Position: Normally open.
- E. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

# F. Controls:

1. Factory install controls furnished as part of temperature controls system specified in Division 23 Section "Direct Digital Control (DDC) System for HVAC."

# 2.3 CASING LINER

- A. Casing Liner: Flexible elastomeric duct liner fabricated of preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
  - 1. Minimum Thickness: 1/2 inch.
  - 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  - 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
    - a. Adhesive shall have a VOC content of 80 g/L or less.
    - b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

# 2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to AHRI 880.
  - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

# PART 3 - EXECUTION

## 3.1 HANGER AND SUPPORT INSTALLATION

- A. Comply with with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.

- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 3.2 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7. Comply with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on air terminal units that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
  - 1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavyduty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

# 3.3 TERMINAL UNIT INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

- C. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- D. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- E. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.
- F. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."
- G. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

## 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Air terminal unit will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

#### 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

## SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Square ceiling diffusers.
  - 2. Adjustable bar registers and grilles.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

#### PART 2 - PRODUCTS

## 2.1 CEILING DIFFUSERS

- A. Square Ceiling Diffusers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carnes.
    - b. Titus.
    - c. Price
  - 2. Material: Steel.
  - 3. Finish: Baked enamel, white.
  - 4. Characteristics: See Drawings

# 2.2 REGISTERS AND GRILLES

A. Adjustable and Fixed Bar Registers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Carnes.
  - b. Titus.
  - c. Price
- 2. Characteristics: As indicated.
- 2.3 SOURCE QUALITY CONTROL
  - A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

# 3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

#### 3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

# SECTION 233723 - HVAC GRAVITY VENTILATORS

# PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Roof hoods.

# 1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
  - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- B. Seismic Performance: Ventilators, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

# 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Submittals:
  - 1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 "Systems and Equipment."
- C. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
- D. Samples: For each exposed product and for each color and texture specified.

## 1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For ventilators, accessories, and components, from manufacturer.

## 1.5 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

# PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
  - 1. Use types and sizes to suit unit installation conditions.
  - 2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
- E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

# 2.2 FABRICATION, GENERAL

- A. Factory fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.

## 2.3 ROOF HOODS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acme Engineering & Manufacturing Corp.
  - 2. Greenheck Fan Corporation.
  - 3. Loren Cook Company.
- B. Factory fabricated according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figures 6-6 and 6-7.
- C. Materials: Galvanized-steel sheet, minimum 0.064-inch-thick base and 0.040-inch-thick hood; suitably reinforced.
- D. Roof Curbs: Galvanized-steel sheet; with 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 fit roof opening and ventilator base.
  - 1. Configuration: Self-flashing without a cant strip, with mounting flange.
  - 2. Overall Height: 16 inches.
- E. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.
  - 1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
  - 2. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
    - a. Color and Gloss: As selected by Architect from manufacturer's full range.
- F. Capacities and Characteristics: As indicated.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Secure gravity ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible. Refer to Section 077200 "Roof Accessories."
- C. Install gravity ventilators with clearances for service and maintenance.

- D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.
- F. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
- G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

END OF SECTION 233723

# SECTION 234100 - PARTICULATE AIR FILTRATION

# PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Pleated panel filters.

# 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
  - 1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 "Systems and Equipment."
  - 2. Product Data: For air filtration performance.
- C. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.

# 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

## 1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

## PART 2 - PRODUCTS

# 2.1 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance:
  - 1. Comply with applicable requirements in ASHRAE 62.1, Section 4 "Outdoor Air Quality"; Section 5 "Systems and Equipment"; and Section 7 "Construction and Startup."
  - 2. Comply with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.
- B. Comply with NFPA 90A and NFPA 90B.

# PARTICULATE AIR FILTRATION

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

# 2.2 PLEATED PANEL FILTERS

- A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.
- B. Filter Unit Class: UL 900, Class 1.
- C. Media: Cotton and synthetic fibers coated with nonflammable adhesive.
  - 1. Media shall be coated with an antimicrobial agent.
  - 2. Separators shall be bonded to the media to maintain pleat configuration.
  - 3. Welded-wire grid shall be on downstream side to maintain pleat.
  - 4. Media shall be bonded to frame to prevent air bypass.
  - 5. Support members on upstream and downstream sides to maintain pleat spacing.
- D. Filter-Media Frame: Cardboard frame with perforated metal retainer sealed or bonded to the media.
- E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- F. Capacities and Characteristics:1. MERV Rating: 13 when tested according to ASHRAE 52.2.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- B. Install filters in position to prevent passage of unfiltered air.
- C. Install filter gage for each filter bank.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
- E. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.
- F. Coordinate filter installations with duct and air-handling-unit installations.

## 3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:1. Test for leakage of unfiltered air while system is operating.
- C. Air filter will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

## 3.3 CLEANING

A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 234100

# SECTION 237313 - INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

A. Section Includes:1. Variable-air-volume, single-zone air-handling units.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of L/100 where "L" is the unsupported span length within completed casings.
- C. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each air-handling unit indicated.
  - 1. Unit dimensions and weight.
  - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
  - 3. Fans:
    - a. Certified fan-performance curves with system operating conditions indicated.
    - b. Certified fan-sound power ratings.
    - c. Fan construction and accessories.
    - d. Motor ratings, electrical characteristics, and motor accessories.
  - 4. Certified coil-performance ratings with system operating conditions indicated.
  - 5. Dampers, including housings, linkages, and operators.

- 6. Filters with performance characteristics.
- B. Sustainable Design Submittals:
  - 1. <u>Product data showing compliance with ASHRAE 62.1.</u>
- C. Delegated-Design Submittal: For vibration isolation and seismic restraints 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor 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. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
  - 2. Support location, type, and weight.
  - 3. Field measurements.
- B. Seismic Qualification Data: Certificates, for air-handling units, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Source quality-control reports.
- D. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units 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. Filters: One set(s) for each air-handling unit.
  - 2. Gaskets: One set(s) for each access door.

### 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. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of airhandling units and components.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and Startup."
- D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 "Heating, Ventilating, and Air-Conditioning."
- E. Comply with NFPA 70.

#### 1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

#### PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
  - 1. Aaon Inc.
  - 2. Daikin International
  - 3. JCI York Solutions

#### 2.2 GENERAL

A. filters, supply fans, hot water coil, mixing box, unit controls.

#### INDOOR CENTRAL-STATION AIR-HANDLING UNITS

- B. Configuration: Draw-through supply fan configuration, discharge air horizontally.
- C. Factory assembled and tested including leak testing coils, run testing of supply fans and factory wired electrical system. Run test report supplied with the unit.
- D. Decals and tags to indicate lifting and rigging, service areas, and caution areas.
- E. Laminated color-coded wiring diagram to match factory installed wiring, affixed to interior of the control compartment's access door.

## 2.3 CONSTRUCTION

- A. Cabinet walls and access doors double wall, impact resistant, rigid polyurethane foam panels.
- B. Unit insulation minimum thermal resistance R-value 6.25. Foam insulation density of 2 pounds/cubic foot, be tested in accordance with ASTM D-1929-11 for minimum flash ignition temperature of 610°F.
- C. Unit construction shall be double wall, G90 galvanized steel on both sides, thermal break.
- D. Designed to reduce air leakage and infiltration through cabinet. Sealing included between panels and between access doors and openings to reduce air leakage. Sealed piping and electrical conduit through cabinet panels to reduce air leakage.
- E. Access to filters, cooling coil, reheat coil, heating coil, supply fans and electrical and controls components through hinged service access doors.
- F. Access doors flush mounted to cabinetry. Coil access door and supply fan access door with quarter-turn lockable handles. Supply fan access door with removable pin hinges.

## 2.4 ELECTRICAL

- A. external control panel with separate low voltage control wiring with conduit and high voltage power wiring, conduit between control panel and unit. Field wired control panel.
- B. Standard power block for connecting power to the unit.
- C. Factory installed 24V control circuit transformer.

## 2.5 SUPPLY FANS

- A. direct drive unhoused, backward curved, plenum supply fans.
- B. High efficiency electronically commutated motor.
- C. Dynamically balanced blower and motor assembly.
- D. Blower and motor assembly isolated with neoprene gasket.

E. ECM driven supply fan speed controlled with field provided 0-10 VDC control signal.

## 2.6 HEATING COIL

- A. Hot Water Heating Coil
  - 1. AHRI Standard 410 certified, hydrogen or helium leak tested.
  - 2. Copper tubes, aluminum fins mechanically bonded to tubes, aluminum end casings. Sine wave rippled fin design.
  - 3. Left or right hand external piping connections as indicated. Sweat connection supply and return connections. Coil connections labeled, extend beyond the unit casing, factory sealed on both the interior and exterior of unit casing, to minimize air leakage.

## 2.7 FILTERS

A. 4 inch thick, pleated panel filters,85% ASHRAE efficiency, MERV 13 rating. 2 inch thick, pleated panel pre-filters, 30% ASHRAE efficiency, MERV 8 rating, upstream of 4 inch standard filters.

## 2.8 MIXING BOX

- A. Mixing box with return air opening and outside air opening as indicated.
- B. Outside air damper and return air damper constructed of extruded aluminum, hollw core, airfoil blades, rubber edge seals, aluminum end seals. Fully modulating.

## 2.9 CONTROLS

- A. Factory Installed and Factory Provided Controller
  - 1. Unit controller capable of controlling all features and options of unit. Controller factory installed in unit controls compartment, factory tested.
  - 2. Controller capable of stand alone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on building management system.
  - 3. Onboard clock and calendar functions for occupancy scheduling.
  - 4. Non-volatile memory to retain all programmed values, without external battery, in the event of a power failure.
  - 5. Variable Air Volume Controller
    - a. Variable speed supply fan system to modulate airflow as required to meet space temperature demands. Modulate fan speed based on supply air duct static pressure.
    - b. Modulate heating with constant airflow to meet space temperature heating loads. Modulate capacity based on supply air temperature.

- c. Return air temperature sensor, outside air temperature sensor, supply air temperature sensor and supply air duct static pressure sensor field installed.
- d. Control of supply airflow, for duct static pressure control, shall be with unit controller, factory electronically commutated motor and supply air duct static pressure sensor.
- 6. BACnet Network Interface: Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, push button override, and occupancy scheduling, LCD screen and input keypad available to building EMCS

# 2.10 ACCESSORIES

A. Factory installed smoke detector wired to shut off unit on detection of smoke.

## 2.11 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

## PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

# 3.2 INSTALLATION

- A. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

- 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- B. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- C. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- E. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

# 3.3 CONNECTIONS

- A. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- D. Hot-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- E. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

#### 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. Tests and Inspections:

- 1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
- 2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- E. Prepare test and inspection reports.

## 3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that shipping, blocking, and bracing are removed.
  - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
  - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
  - 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
  - 6. Verify that zone dampers fully open and close for each zone.
  - 7. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
  - 8. Comb coil fins for parallel orientation.
  - 9. Install new, clean filters.
  - 10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
  - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
  - 2. Measure and record motor electrical values for voltage and amperage.
  - 3. Manually operate dampers from fully closed to fully open position and record fan performance.

# 3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

## 3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

## 3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237313

# SECTION 237416 - PACKAGED ROOFTOP HEATING AND VENTILATING UNITS

PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes packaged, heating and ventilating units (AHUs) with the following components and accessories:
  - 1. Casings.
  - 2. Fans.
  - 3. Motors.
  - 4. Rotary heat exchanger.
  - 5. Coils.
  - 6. Air filtration.
  - 7. Dampers.
  - 8. Electrical power connections.
  - 9. Controls.
  - 10. Accessories
  - 11. Roof curbs.

#### 1.3 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. ECM: Electronically commutated motor.
- C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- D. AHU: Rooftop unit. As used in this Section, this abbreviation means packaged, rooftop heating and ventilating units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- E. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

## 1.4 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each AHU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
  - 1. Factory selection calculations for each UVGI installation.
- B. Sustainable Design Submittals:
  - 1. Product Data: For adhesives, mastics, and sealants, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.
  - 3. Product Data: For energy performance.
- C. 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 diagrams for power, signal, and control wiring.
- D. Delegated-Design Submittal: For AHU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
  - 2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
  - 3. Wind- and Seismic-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: 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. Structural members to which AHUs will be attached.
  - 2. Roof openings.
  - 3. Roof curbs and flashing.
- B. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.

- 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
- 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Seismic Qualification Certificates: For AHUs, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - 4. Restraint of internal components, including fans, coils, and refrigeration components.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For AHUs to include in emergency, operation, and maintenance manuals.

#### 1.7 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. Fan Belts: One set(s) for each belt-driven fan.
  - 2. Filters: One set(s) of filters for each unit.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of AHUs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 SYSTEM DESCRIPTION

- A. AHRI Compliance:
  - 1. Comply with AHRI 270 for testing and rating sound performance for AHUs.

- 2. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.
- B. AMCA Compliance:
  - 1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
  - 2. Damper leakage tested in accordance with AMCA 500-D.
  - 3. Operating Limits: Classify according to AMCA 99.
- C. ASHRAE Compliance:
  - 1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
  - 2. Comply with applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and Startup."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 "Heating, Ventilating, and Air-Conditioning."
- E. NFPA Compliance: Comply with NFPA 90A or NFPA 90B.
- F. UL Compliance: Comply with UL 1995.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AAON.
  - 2. Daikin Applied.
  - 3. JCI York Solutions.

## 2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design mounting and restraints for AHUs, including comprehensive engineering analysis.
  - 1. Design AHU supports to comply with wind and seismic performance requirements.
- B. Wind-Restraint Performance: Perforamance requirements as indicated on Structural Contract Documents.
- C. Seismic Performance: AHUs shall withstand the effects of earthquake motions determined according to ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified".

## 2.4 CONSTRUCTION

- A. Cabinet Walls, Access Doors, and Roof: Double wall, impact resistant, rigid polyurethane foam panels.
- B. Insulation: Minimum R-value of 13. Foam insulation minimum density of 2 pounds/cubic foot.Tested in accordance with ASTM D-1929-11 for a minimum flash ignition temperature of 610°F.
- C. Unit Construction: Double wall, G90 galvanized steel on both sides, thermal break.
- D. Leakage: Cabinet leakage not to exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection not to exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure. Deflection measured at the midpoint of panel height and width. Continuous sealing included between panels, access doors and
- E. Rain Drainage: Air tunnel roof sloped to provide complete drainage. Cabinet with rain break overhangs above access doors.
- F. Access: Filters, dampers, heating coil, exhaust fans, energy recovery wheels, and electrical and controls components through hinged access doors with quarter turn, lockable handles. Full length stainless steel piano hinges.
- G. Exterior Finish: Capable of withstanding 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
- H. Configuration: Vertical supply and return.
- I. Lifting Lugs: On top of unit.
- J. Base Pan Insulation: 1/2" thick foam insulation.

## 2.5 ELECTRICAL

A. Power Connection: Standard power plock.

## 2.6 SUPPLY-AIR FANs

- A. Fan: Direct drive, unhoused, backward curved, plenum supply fan, AMCA fan classification to meet operating conditions, but no less than AMCA Class II.
- B. Balancing: Blowers and motors shall dynamically balanced and mounted on rubber isolators.
- C. Motors: Premium efficiency ODP, ball bearings rated for 200,000 hours service with external lubrication points.
- D. Variable Frequency Drives: Factory wired and mounted in unit. Retain one of two "Fan Type" subparagraphs below.

# 2.7 EXHAUST FANS

- A. Dampers: Sized for 100% relief.
- B. Fans: Belt driven, unhoused, backward curved, plenum exhaust fans. AMCA fan classification to meet operating conditions, but no less than AMCA Class II.
- C. Balancing: Blowers and motors shall dynamically balanced and mounted on rubber isolators.
- D. Motors: Premium efficiency ODP, ball bearings rated for 200,000 hours service with external lubrication points.
- E. Access: Double wall, hinged access doors with quarter turn handles.
- F. Variable Frequency Drives: Factory wired and mounted in unit. Retain one of two "Fan Type" subparagraphs below.

#### 2.8 HEATING COILS

- A. Hot Water Heating Coils
  - 1. Certification: AHRI Standard 410, hydrogen or helium leak tested.
  - 2. Construction: Copper tubes, aluminum fins mechanically bonded to tubes, galvanized steel end casings. Sine wave rippled fin design.
  - 3. Location: Downstream of supply fans.

## 2.9 FILTERS

- A. Final Filter: 4 inch thick, pleated panel filters, ASHRAE efficiency 85%, MERV 13, upstream of the heating coil.
- B. Pre-filter: 2 inch thick, pleated panel pre filters, ASHRAE efficiency 30%, MERV 8, upstream.

## 2.10 OUTSIDE AIR ECONOMIZER

- A. General: 0-100% economizer, motor operated outside air damper, return air damper assembly extruded aluminum construction, hollow core, airfoil blades, rubber edge, end seals. Damper gear driven maximum 20 cfm leakage per sq ft. at 4 in. w.g. air pressure differential across damper. Class 2 AMCA certified dampers, per AMCA Standard 511. Spring return damper control assembly, DDC actuator. Outside air opening bird screen, outside air hood, barometric relief dampers.
- B. CO2 Override: Return air.

## 2.11 ENERGY RECOVERY

- A. General: Factory mounted and tested energy recovery wheel. Wheel mounted in rigid frame containing wheel drive motor, drive belt, wheel seals and bearings. Insulated cassette fram complete with seals.
- B. Service: Slide out service and removal from the cabinet.
- C. The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt.
- D. Wheel Construction:
  - 1. Wound continuously with one flat and one structured layer, parallel plate geometry laminar flow, minimum pressure drop-to-efficiency ratios. Layers captured in stainless steel wheel frames or aluminum and stainless steel segment.
  - 2. Removable energy transfer matrix. Welded hub, spoke and rim assembly of stainless, plated and/or coated steel, self-supporting without matrix segments in place. Segments removable without use tools. Wheel bearings L-10 life in excess of 400,000 hours. Rim continuous rolled stainless steel, wheel connected to shaft by means of taper locks.
  - 3. All diameter and perimeter seals provided as part of cassette assembly, factory set. Stretch urethane drive belts, wheel rim drive without external tensioners or adjustment.
  - 4. Underwriters Laboratories Recognized Component for electrical and fire safety. Motor Underwriters Laboratory Recognized Component, mounted in cassette frame, service connector or junction box. Thermal performance shall be certified by manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment. Cassettes shall be listed in the AHRI Certified Products.
  - 5. Energy Recovery Wheel Warranty: 5 year non-prorated warranty, from the date of substantial completion. 5 year warranty applicable to all parts and components of cassette, except motor. 18 month motor.

- 6. Energy Recovery Module Filters: 2 inch thick, pleated panel outside air and exhaust air filters, 30% ASHRAE, MERV 8, upstream of wheels.
- 7. Access: Hinged service access doors.
- 8. Construction: Sensible energy recovery wheels constructed of lightweight polymer, without desiccant coating. Washable segments.
- 9. Defrost Control: Adjustable temperature sensor and timer wired to periodically stop wheel rotation.

## 2.12 CONTROLS

- A. Factory Installed and Factory Provided Controller:
  - 1. Capable of controlling all features and options. Factory installed in unit controls compartment and factory tested.
  - 2. Capable of standalone operation with unit configuration, set point adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
  - 3. Onboard clock and calendar functions for occupancy scheduling.
  - 4. Non-volatile memory to retain all programmed values, without external battery.
  - 5. Single Zone VAV
    - a. Variable speed fan system to modulate cooling and airflow as required to meet space temperature demand. Unit fan speed to modulate based on space temperature.
    - b. Capable of modulating fan speed in both the heating and ventilating mode.
    - c. BACnet Network Interface: Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, push button override, and occupancy scheduling, LCD screen and input keypad available to building EMCS.
  - 6. Smoke Detector: Return air, wired to shut off unit control circuit.

## 2.13 RESTRAINED ISOLATION ROOF-CURB

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. California Dynamics Corporation.
  - 2. Kinetics Noise Control, Inc.
  - 3. Mason Industries, Inc.

- B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
- C. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces.
- D. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- F. Full perimeter, including piping cabinet.

## 2.14 MOTORS

- A. Comply with NEMA MG 1, Design B, medium induction motor, unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.
- C. 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.
- D. Duty: Continuous duty at ambient temperature of 104 deg F and at altitude of 3300 feet above sea level.
- E. 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.
- F. Efficiency: Energy efficient, as defined in NEMA MG 1.
- G. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements.
- H. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- I. Multispeed Motors: Separate winding for each speed.
- J. Rotor: Random-wound, squirrel cage.

- K. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- L. Temperature Rise: Match insulation rating.
- M. Insulation: Class F.
- N. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- O. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- P. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- Q. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

#### 2.15 ACCESSORIES

- A. Recirculation damper.
- B. Energy recovery wheel bypass damper.
- C. Outdoor air intake weather hood with moisture eliminator.
- D. Piping cabinet for routing piping external to unit.

## 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 AHUs.
- B. Examine roughing-in for AHUs to verify actual locations of piping and duct connections before equipment installation.

- C. Examine roofs for suitable conditions where AHUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

# 3.2 INSTALLATION

- A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." Install AHUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure AHUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
  - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

#### 3.3 CONNECTIONS

- A. Install piping in pipe cabinet at AHUs to allow service and maintenance.
- B. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
  - 1. Install ducts to termination at top of roof curb.
  - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
  - 3. Connect supply ducts to AHUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
  - 4. Install return-air duct continuously through roof structure.

## 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 tests and inspections with the assistance of a factory-authorized service representative:
  - 1. After installing AHUs 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. AHU will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
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# 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.
  - 1. Inspect for visible damage to unit casing.
  - 2. Inspect for visible damage to furnace combustion chamber.
  - 3. Inspect for visible damage to compressor, coils, and fans.
  - 4. Inspect internal insulation.
  - 5. Verify that labels are clearly visible.
  - 6. Verify that clearances have been provided for servicing.
  - 7. Verify that controls are connected and operable.
  - 8. Verify that filters are installed.
  - 9. Remove packing from vibration isolators.
  - 10. Inspect operation of barometric relief dampers.
  - 11. Verify lubrication on fan and motor bearings.
  - 12. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  - 13. Adjust fan belts to proper alignment and tension.
  - 14. Start unit according to manufacturer's written instructions.
    - a. Do not operate below recommended low-ambient temperature.
    - b. 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. Calibrate thermostats.
  - 18. Adjust and inspect high-temperature limits.
  - 19. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
  - 20. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
  - 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.
  - 22. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
    - a. High-temperature limit on gas-fired heat exchanger.
    - b. Low-temperature safety operation.
    - c. Filter high-pressure differential alarm.
    - d. Economizer to minimum outdoor-air changeover.
    - e. Relief-air fan operation.
    - f. Smoke and firestat alarms.

23. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

## 3.6 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing AHU and airdistribution systems, clean filter housings and install new filters.

# 3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain AHUs.

END OF SECTION 237416

# SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

# PART 1 - GENERAL

## 1.1 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
  - 2. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 "Systems and Equipment."
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

# 1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

# 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- 1.5 QUALITY ASSURANCE
  - A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - B. ASHRAE Compliance:
    - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

- ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: One year(s) from date of Substantial Completion.
    - c. For Labor: One year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mitsubishi Electric & Electronics USA, Inc.
  - 2. SANYO North America Corporation.
  - 3. Trane.

# 2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Wall-Mounted, Evaporator-Fan Components:
  - 1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
  - 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermalexpansion valve. Comply with ARI 206/110.
  - 3. Fan: Direct drive, centrifugal.
  - 4. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    - c. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.

- d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
- e. Mount unit-mounted disconnect switches on interior of unit.
- 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- 6. Condensate Drain Pans:
  - 1) Length: Extend drain pan downstream from leaving face <Insert distance>.
  - 2) Depth: A minimum of 1 inch deep.
  - b. Single-wall.
  - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
    - 1) Minimum Connection Size: 19/32 in.
- 7. Air Filtration Section:
  - a. General Requirements for Air Filtration Section:
    - 1) Comply with NFPA 90A.
  - b. Disposable Panel Filters:
    - 1) Factory-fabricated, viscous-coated, flat-panel type.

## 2.3 OUTDOOR UNITS (5 TONS OR LESS)

- A. Air-Cooled, Compressor-Condenser Components:
  - 1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
  - 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
    - a. Compressor Type: DC inverter, twin rotary.
    - b. Refrigerant Charge: R-410A.
    - c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
  - 3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
  - 4. Fan: Aluminum-propeller type, directly connected to motor.
  - 5. Motor: Permanently lubricated, with integral thermal-overload protection.
  - 6. Low Ambient Kit: Permits operation down to 45 deg F.
  - 7. Mounting Base: Polyethylene.

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## 2.4 ACCESSORIES

- A. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
  - 1. Compressor time delay.
  - 2. 24-hour time control of system stop and start.
  - 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  - 4. Fan-speed selection including auto setting.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Drain Hose: For condensate.
- E. Condensate pump.
- F. Condensate pan overflow switch.
- G. Additional Monitoring:
  - 1. Monitor constant and variable motor loads.
  - 2. Monitor variable-frequency-drive operation.
  - 3. Monitor economizer cycle.
  - 4. Monitor cooling load.
  - 5. Monitor air distribution static pressure and ventilation air volumes.

# 2.5 CAPACITIES AND CHARACTERISTICS

- A. Cooling Capacity: As indicated.
- B. Heating Capacity: As indicated.

# PART 3 - EXECUTION

# 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

# 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

## 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. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

# 3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

# 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. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

## 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

# PART 2 - PRODUCTS

# 2.1 CONDUCTORS AND CABLES

- 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. Alpha Wire.
  - 2. Belden Inc.
  - 3. Encore Wire Corporation.
  - 4. General Cable Technologies Corporation.
  - 5. Southwire Incorporated.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2and Type SO.

# 2.2 CONNECTORS AND SPLICES

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. AFC Cable Systems, Inc.
- 2. Gardner Bender.
- 3. Hubbell Power Systems, Inc.
- 4. Ideal Industries, Inc.
- 5. Ilsco; a branch of Bardes Corporation.
- 6. NSi Industries LLC.
- 7. O-Z/Gedney; a brand of the EGS Electrical Group.
- 8. 3M; Electrical Markets Division.
- 9. Tyco Electronics.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

# 2.3 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 NFPA 70.

# 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, except VFC cable, which shall be extra flexible stranded.

# 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

- 1. Metal-clad cable, Type MC, may be used within rooms from j-box in ceiling space or other accessible space to devices. Home runs and branch circuits to the rooms must be THHN-2-THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainlesssteel, wire-mesh, strain relief device at terminations to suit application.

# 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 torquetightening 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.

## 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.

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## 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."

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 systems and equipment.

## 1.3 ACTION SUBMITTALS

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

## 1.4 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. Comply with UL 467 for grounding and bonding materials and equipment.

# PART 2 - PRODUCTS

#### 2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:

- 1. No. 4 AWG minimum, soft-drawn copper.
- 2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.
- D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

## 2.2 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. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## 2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

# PART 3 - EXECUTION

# 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 24 inches (600 mm) below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

- 1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
- 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except as otherwise indicated.
  - 3. Connections to Ground Rods: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

## 3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Pad-Mounted Transformers: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

## 3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to ductmounted 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.
- C. Water Heater: Install a separate insulated equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.
- D. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
  - 1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  - 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
  - 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

E. Metal and Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

# 3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

- G. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.
  - 1. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

## 3.5 LABELING

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
  - 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

END OF SECTION 260526

# SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
  - 1. Section 260548 "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

## 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- B. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.

- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze hangers. Include Product Data for components.
  - 2. Steel slotted channel systems. Include Product Data for components.
  - 3. Equipment supports.

## 1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

## 1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

## PART 2 - PRODUCTS

#### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
    - g. Wesanco, Inc.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) MKT Fastening, LLC.
  - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  - 5. Toggle Bolts: All-steel springhead type.
  - 6. Hanger Rods: Threaded steel.

# 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

# PART 3 - EXECUTION

# 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

# 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 may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts. To Light Steel: Sheet metal screws.
  - 6. 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 meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

# 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in 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.

## 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

## 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

# SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Metal conduits, tubing, and fittings.
  - 2. Nonmetal conduits, tubing, and fittings.
  - 3. Metal wireways and auxiliary gutters.
  - 4. Surface raceways.
  - 5. Boxes, enclosures, and cabinets.
  - 6. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
  - 1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

# 1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

# PART 2 - PRODUCTS

## 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 3. Anamet Electrical, Inc.
  - 4. Electri-Flex Company.
  - 5. O-Z/Gedney; a brand of EGS Electrical Group.
  - 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
  - 7. Republic Conduit.
  - 8. Robroy Industries.
  - 9. Southwire Company.
  - 10. Thomas & Betts Corporation.
  - 11. Western Tube and Conduit Corporation.
  - 12. Wheatland Tube Company; a division of John Maneely Company.
- B. 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.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: compression.
  - 2. 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.
- I. Joint Compound for IMC, GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Anamet Electrical, Inc.
  - 3. Arnco Corporation.
  - 4. CANTEX Inc.
  - 5. CertainTeed Corp.
  - 6. Condux International, Inc.
  - 7. Electri-Flex Company.
  - 8. Kraloy.
  - 9. Lamson & Sessions; Carlon Electrical Products.
  - 10. Niedax-Kleinhuis USA, Inc.
  - 11. RACO; a Hubbell company.
  - 12. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic 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.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Fittings for RNC: Comply with NEMA TC 3; match to conduit type and material.
- E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- 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. Cooper B-Line, Inc.
  - 2. Hoffman; a Pentair company.
  - 3. Mono-Systems, Inc.
  - 4. Square D; a brand of Schneider Electric.
- 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.

## 2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
  - 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. Mono-Systems, Inc.
    - b. Panduit Corp.
    - c. Wiremold / Legrand.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
  - 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. Hubbell Incorporated; Wiring Device-Kellems Division.
    - b. Mono-Systems, Inc.
    - c. Panduit Corp.
    - d. Wiremold / Legrand.

#### 2.5 BOXES, ENCLOSURES, AND CABINETS

- 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. Adalet.
  - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 3. EGS/Appleton Electric.
  - 4. Erickson Electrical Equipment Company.
  - 5. FSR Inc.
  - 6. Hoffman; a Pentair company.
  - 7. Hubbell Incorporated; Killark Division.
  - 8. Kraloy.
  - 9. Milbank Manufacturing Co.
  - 10. Mono-Systems, Inc.
  - 11. O-Z/Gedney; a brand of EGS Electrical Group.
  - 12. RACO; a Hubbell Company.
  - 13. Robroy Industries.
  - 14. Spring City Electrical Manufacturing Company.

- 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
- 16. Thomas & Betts Corporation.
- 17. Wiremold / Legrand.
- 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.
  - 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. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- L. Gangable boxes are prohibited.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

## 2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

- 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
- 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
  - 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. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation; Hubbell Power Systems.
    - d. NewBasis.
    - e. Oldcastle Precast, Inc.; Christy Concrete Products.
    - f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
  - 2. Standard: Comply with SCTE 77.
  - 3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
  - 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  - 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 6. Cover Legend: Molded lettering, "ELECTRIC.".
  - 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  - 8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
  - 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. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation; Hubbell Power Systems.
    - d. NewBasis.
    - e. Nordic Fiberglass, Inc.
    - f. Oldcastle Precast, Inc.; Christy Concrete Products.
    - g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
  - 2. Standard: Comply with SCTE 77.
  - 3. Color of Frame and Cover: Gray.
  - 4. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.

- 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
- 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- 7. Cover Legend: Molded lettering, "ELECTRIC."
- 8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- 9. Handholes: 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

# PART 3 - EXECUTION

# 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: EMT.
  - 3. Underground Conduit: Type EPC-40-PVC, direct buried.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  - 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.
  - 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded 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 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.
- E. Install surface raceways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

# 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hotwater pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. 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 (300 mm) of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- L. 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 (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- N. 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.
- O. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- Q. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch (50-mm)radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- R. 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 an underground service raceway enters a building or structure.
  - 2. Where otherwise required by NFPA 70.
- S. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- T. Expansion-Joint Fittings:
  - 1. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  - 2. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

- U. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) 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 not subject to severe physical damage.
- V. 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.
- W. 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 raintight connection between box and cover plate or supported equipment and box.
- X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Y. Locate boxes so that cover or plate will not span different building finishes.
- Z. 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.
- AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- BB. Set metal floor boxes level and flush with finished floor surface.

# 3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
  - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
  - 2. Install backfill as specified in Section 312000 "Earth Moving."
  - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
  - 4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

- b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
- 5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

# 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

# 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR 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."

# 3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

# 3.7 **PROTECTION**

- A. Protect coatings, finishes, and cabinets from damage 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 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
  - 2. Handholes and boxes.

## 1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Duct-bank materials, including separators and miscellaneous components.
  - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  - 3. Accessories for manholes, handholes, boxes.
  - 4. Warning tape.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
  - 1. Duct entry provisions, including locations and duct sizes.
  - 2. Reinforcement details.
  - 3. Frame and cover design and manhole frame support rings.
  - 4. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
  - 5. Joint details.
- C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

- 1. Duct entry provisions, including locations and duct sizes.
- 2. Cover design.
- 3. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

# 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C 858.
- B. Source quality-control test reports.

#### 1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

#### 1.8 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Owner's written permission.

## 1.9 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

# PART 2 - PRODUCTS

## 2.1 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

#### 2.2 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Carder Concrete Products.
  - 2. Christy Concrete Products.
  - 3. Elmhurst-Chicago Stone Co.
  - 4. Oldcastle Precast Group.
  - 5. Riverton Concrete Products; a division of Cretex Companies, Inc.
  - 6. Utility Concrete Products, LLC.
  - 7. Utility Vault Co.
  - 8. Wausau Tile, Inc.
- C. Comply with ASTM C 858 for design and manufacturing processes.
- D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
  - 1. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
    - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
    - b. Cover Handle: Recessed.
  - 2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 3. Cover Legend: Molded lettering, "ELECTRIC" or "TELEPHONE" as indicated for each service.
  - 4. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
  - 5. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

# 2.3 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Description: Comply with SCTE 77.
  - 1. Color: Gray.
  - 2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
  - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
  - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 5. Cover Legend: Molded lettering, "ELECTRIC" or "TELEPHONE" as indicated for each service.
  - 6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
  - 7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.
- B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

## PART 3 - EXECUTION

#### 3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EB-20-PVC, in direct buried duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct buried duct bank, unless otherwise indicated.
- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct buried duct bank, unless otherwise indicated.
- D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in direct buried duct bank, unless otherwise indicated.

#### 3.2 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavyduty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Section 017329 "Cutting and Patching."

# 3.3 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1220 mm), both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
  - 1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
  - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to handhole.
  - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
  - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not

use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

- 2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
  - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
  - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
- 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
- 4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
- 5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
- 6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
- 7. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
- 8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
- 9. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.
- I. Direct-Buried Duct Banks:
  - 1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
  - 2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.

- 3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
- 4. Install backfill as specified in Section 312000 "Earth Moving."
- 5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
- 6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
- 7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
- 8. Set elevation of bottom of duct bank below the frost line.
- 9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
  - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

# 3.4 INSTALLATION OF CONCRETE HANDHOLES AND BOXES

- A. Precast Concrete Handhole Installation:
  - 1. Comply with ASTM C 891, unless otherwise indicated.
  - 2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
  - 3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- B. Elevations:
  - 1. Install handholes with bottom below the frost line, below grade.
  - 2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
- C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

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#### 3.5 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

# 3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
  - 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for outof-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

# 3.7 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION 260543

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND 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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.
- B. Related Requirements:
  - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fireresistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

# PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Wall Sleeves:
  - 1. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- C. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

- D. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- E. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

# 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. CALPICO, Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
    - e. Proco Products, Inc.
  - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel.
  - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

# 2.3 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-firerated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

#### PART 3 - EXECUTION

# 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

#### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

#### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

#### END OF SECTION 260544

# SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Channel support systems.
  - 2. Hanger rod stiffeners.
  - 3. Anchorage bushings and washers.
- B. Related Sections include the following:
  - 1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

#### 1.3 DEFINITIONS

A. The IBC: International Building Code.

# 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
  - 1. Site Class as Defined in the IBC: D
  - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
    - a. Component Importance Factor: 1.0.
    - b. Component Response Modification Factor: 1.5.
    - c. Component Amplification Factor: 1.0.
  - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): See General Structural Notes
  - 4. Design Spectral Response Acceleration at 1.0-Second Period: See General Structural Notes,

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#### 1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
    - b. Annotate to indicate application of each product submitted and compliance with requirements.
  - 3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
  - 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
  - 3. Field-fabricated supports.
  - 4. Seismic-Restraint Details:
    - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
    - c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES. showing maximum ratings of restraint items and the basis for approval (tests or calculations).

#### 1.6 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or

preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

# PART 2 - PRODUCTS

# 2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Ace Mountings Co., Inc.
  - 2. Amber/Booth Company, Inc.
  - 3. California Dynamics Corporation.
  - 4. Isolation Technology, Inc.
  - 5. Kinetics Noise Control.
  - 6. Mason Industries.
  - 7. Vibration Eliminator Co., Inc.
  - 8. Vibration Isolation.
  - 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
  - 1. Resilient Material: Oil- and water-resistant neoprene.
- C. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
  - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
  - 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
  - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

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#### 2.2 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Amber/Booth Company, Inc.
  - 2. California Dynamics Corporation.
  - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
  - 4. Hilti Inc.
  - 5. Loos & Co.; Seismic Earthquake Division.
  - 6. Mason Industries.
  - 7. TOLCO Incorporated; a brand of NIBCO INC.
  - 8. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES.
  - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive.

Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

# 2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  - 1. Powder coating on springs and housings.
  - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  - 3. Baked enamel or powder coat for metal components on isolators for interior use.
  - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

#### PART 3 - EXECUTION

# 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

# 3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
  - 1. Install restrained isolators on electrical equipment.

- 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
- 3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

# 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

# 3.5 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.

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D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

# SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

# 1.2 SUMMARY

- A. Section Includes:
  - 1. Identification of power and control cables.
  - 2. Identification for conductors.
  - 3. Underground-line warning tape.
  - 4. Warning labels and signs.
  - 5. Instruction signs.
  - 6. Equipment identification labels.
  - 7. Miscellaneous identification products.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Arc Flash Hazard Analysis.

#### 1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

## 1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's

wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Labeling is to be reviewed and approved by the Facilities PM & Electrical Supervisor.
- C. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- D. Coordinate installation of identifying devices with location of access panels and doors.
- E. Install identifying devices before installing acoustical ceilings and similar concealment.
- F. Panels require labeling of necessary PPE with potential hazards as a result of Arc Flash Hazard Analysis. The Arc Flash Hazard Analysis shall be performed by the Electrical Contractor.

# PART 2 - PRODUCTS

# 2.1 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.
- E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

# 2.2 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted or Write-on, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and

chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.
- F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

# 2.3 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

# 2.4 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
  - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

# 2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
  - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
  - 3. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal-Backed, Butyrate Warning Signs:
  - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
  - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
  - 3. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER ELECTRICAL SHOCK HAZARD EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING OSHA REGULATION AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

# 2.6 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

# 2.7 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

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#### 2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
  - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
  - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
  - 5. Color: Black.

# 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

# PART 3 - EXECUTION

# 3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Provide permanent signage, interior and exterior, at all utility boxes, vaults, manholes, etc.
- C. Tag lighting feeds with circuit number and panel ID.

- D. If banks of switching are installed that control various systems (i.e. lighting, AV, and projection screen, etc.) or various spaces (i.e. classroom and corridor, etc.) labeling with 1/8" black letters indicating function of each switch is required.
- E. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- F. Apply identification devices to surfaces that require finish after completing finish work.
- G. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- H. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- I. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- J. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- K. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- L. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
- M. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

# 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Emergency Power.
  - 2. Power.
  - 3. UPS.
- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

- a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
- b. Colors for 208/120-V Circuits:
  - 1) Phase A: Black.
  - 2) Phase B: Red.
  - 3) Phase C: Blue.
- c. Colors for 480/277-V Circuits:
  - 1) Phase A: Brown.
  - 2) Phase B: Orange.
  - 3) Phase C: Yellow.
- d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- C. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.
- G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

- J. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
  - 1. Labeling Instructions:
    - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  - 2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchgear.
    - e. Switchboards.
    - f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - g. Substations.
    - h. Emergency system boxes and enclosures.
    - i. Motor-control centers.
    - j. Enclosed switches.
    - k. Enclosed circuit breakers.
    - l. Enclosed controllers.
    - m. Variable-speed controllers.
    - n. Push-button stations.
    - o. Power transfer equipment.
    - p. Contactors.

- Remote-controlled switches, dimmer modules, and control devices. q.
- Battery-inverter units. r.
- Battery racks. S.
- t.
- Power-generating units. Monitoring and control equipment. u.
- UPS equipment. v.

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 sensors.
- B. Related Requirements:
  - 1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

# PART 2 - PRODUCTS

# 2.1 INDOOR 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. Bryant Electric; a Hubbell company.
  - 2. Cooper Industries, Inc.
  - 3. Leviton Mfg. Company Inc.
  - 4. Lutron Electronics Co., Inc.
  - 5. Sensor Switch, Inc.
  - 6. Square D; a brand of Schneider Electric.
  - 7. Watt Stopper.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.

- 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
- 5. Mounting:
  - a. Sensor: Suitable for mounting in any position on a standard outlet box.
  - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
  - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
- 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
- 7. Bypass Switch: Override the "on" function in case of sensor failure.
- 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.
- C. Dual-Technology Type: 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- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
  - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

# 2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS - SINGLE RELAY (SYMBOL: Sos)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Lutron #MS-A102 or comparable product by one of the following:
  - 1. Bryant Electric; a Hubbell company.
  - 2. Cooper Industries, Inc.
  - 3. Leviton Mfg. Company Inc.
  - 4. Sensor Switch, Inc.
  - 5. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
  - 3. Switch Rating: Not less than 720-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

4. Sensor – Dual technology.

#### 2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS - DUAL RELAY (SYMBOL S<sub>0S2</sub>)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Lutron #MS-A202 or comparable product by one of the following:
  - 1. Bryant Electric; a Hubbell company.
  - 2. Cooper Industries, Inc.
  - 3. Leviton Mfg. Company Inc.
  - 4. Sensor Switch, Inc.
  - 5. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
  - 3. Switch Rating: Not less than 720-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
  - 4. Sensor Dual technology.
  - 5. Program to 50% (1<sup>st</sup> relay) Auto on/ 100% (2<sup>nd</sup> relay) manual on/Auto off.

# 2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS - SINGLE RELAY WITH DIMMING (SYMBOL $S_{OSD}$ )

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Lutron #MS-Z101 or comparable product by one of the following:
  - 1. Bryant Electric; a Hubbell company.
  - 2. Cooper Industries, Inc.
  - 3. Leviton Mfg. Company Inc.
  - 4. Sensor Switch, Inc.
  - 5. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
  - 3. Switch Rating: Not less than 720-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
  - 4. Sensor Infrared.
  - 5. 0-10V dimming output.
  - 6. Enable automatic learning mode.

# ELMIRA HIGH SCHOOL FERN RIDGE SCHOOL DISTRICT ELMIRA, OREGON

## 2.5 LIGHTING CONTROL UNITS

- Basis-of-Design Product Single Relay/Zone: Subject to compliance with requirements, provide Wattstopper Digital Lighting Management products, or comparable products by one of the following.
  - 1. Hubbell Building Automation, Inc.
  - 2. Sensor Switch, Inc. Nlight
  - 3. Lutron Electronics Inc. (PowPak 0-10V)
  - 4. Cooper Industries Inc. (Greengate)
- B. Basis-of-Design Product Multiple Relay/Zone: Subject to compliance with requirements, provide : Subject to compliance with requirements, provide Wattstopper Digital Lighting Management products, or comparable products by one of the following.
  - 1. Hubbell Building Automation, Inc.
  - 2. Sensor Switch, Inc. Nlight
  - 3. Lutron Electronics Inc. (Energi Savr Node)
  - 4. Cooper Industries Inc. (Greengate)
- C. System Description: Stand alone, multi zone lighting control interface to provide control coordination between all fixtures in space. Lighting control unit can consist of a single device with multiple relays/zones or multiple single-relay units to achieve the same functionality. The system shall provide coordination for the following controls.
  - Lighting fixtures Fixtures with 0-10V dimming drivers or ballasts, whether in an area requiring dimming or not, shall be connected to a control unit with 0-10V dimming functionality in order to allow for customization of light levels now or in the future. All purple and grey 0-10V connections shall be made upon installation. Where a lighting control unit exists in a space where all fixtures contain drivers or ballasts designed for switching only, a non-dim lighting control unit may be used.
  - 2. Occupancy Sensors: The occupancy sensors shall connect to control unit either wirelessly or via cat5 cable. Classroom lighting shall be switched by control unit based on occupancy sensor signals.
  - 3. Photocells: Control unit shall interface with photocell in each classroom to dim lighting automatically with significant daylight. Control unit must have a minimum dimming time delay of 30 seconds to avoid changing state during passing clouds or other brief sun obstruction events. During times of peak sunlight, lights shall dim to minimum state instead of switching off to avoid distractions caused by automatic switching. Photocell may be wireless or wired via Cat5 cabling.
  - 4. Wall Switches Dimmers: Manual wall switches and dimmers shall connect to control unit to provide switching/dimming override of lighting, not allowing light levels to exceed automatic daylight dimmed levels for more than 2 hours. Wall switches and dimmers may be wireless or wired via Cat5 cabling.
  - 5. Lighting Fixtures: Where required, Control unit shall provide dimming control of 0-10V dimming fluorescent ballasts and 0-10V dimming drivers for LED fixtures.
  - 6. If applicable, all wireless devices shall have a battery life of 10 years minimum.
  - 7. Division 23: If required by Div 23, Control unit shall have a dry contact to send occupied/unoccupied signal to division 23 equipment in classroom.

- D. System programming is done with hand-held, remote-control tool, iphone or tablet application, or central computer system.
- E. Commissioning: Upon completion of installation, a factory representative shall come to the site to provide final programming and owner training for all lighting control units.

# 2.6 DAYLIGHT-HARVESTING SWITCHING CONTROLS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide photocell compatible with Lighting Control Unit Described in section 2.1 of this article.
- B. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, to detect changes in indoor lighting levels that are perceived by the eye.
- C. Electrical Components, Devices, and Accessories:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
  - 3. Sensor Output: Low voltage digital or analog signal compatible Lighting Control Unit. Sensor is powered by Lighting Control Unit.
  - 4. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lux), with an adjustment for turn-on and turn-off levels within that range.
  - 5. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc (1080 to 10 800 lux), with an adjustment for turn-on and turn-off levels within that range.
  - 6. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc (10 800 to 108 000 lux), with an adjustment for turn-on and turn-off levels within that range.
  - 7. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
  - 8. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
  - 9. Test Mode: User selectable, overriding programmed time delay to allow settings check.
  - 10. Control Load Status: User selectable to confirm that load wiring is correct.

# 2.7 DAYLIGHT-HARVESTING DIMMING CONTROLS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide photocell compatible with Lighting Control Unit Described in section 2.1 of this article.
- B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
  - 1. Lighting control set point is based on two lighting conditions:
    - a. When no daylight is present (target level).
    - b. When significant daylight is present.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.

- 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 2. Sensor Output: Low voltage digital or analog signal compatible Lighting Control Unit. Sensor is powered by Lighting Control Unit.
- 3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).

#### 2.8 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."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

#### PART 3 - EXECUTION

# 3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

#### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpowerlimited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

#### 3.3 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.
- B. Label time switches and contactors with a unique designation.

#### 3.4 ADJUSTING

- A. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
- B. Photosensors

END OF SECTION 260923

#### SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

#### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.

#### 1.3 ACTION SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

# 1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

#### 1.6 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchorbolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

# PART 2 - PRODUCTS

# 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. ACME Electric Corporation; Power Distribution Products Division.
  - 2. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
  - 3. Controlled Power Company.
  - 4. Eaton Electrical Inc.; Cutler-Hammer Products.
  - 5. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
  - 6. General Electric Company.
  - 7. Hammond Co.; Matra Electric, Inc.
  - 8. Magnetek Power Electronics Group.
  - 9. Micron Industries Corp.
  - 10. Myers Power Products, Inc.
  - 11. Siemens Energy & Automation, Inc.
  - 12. Sola/Hevi-Duty.
  - 13. Square D; Schneider Electric.

# 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material: Aluminum.

#### 2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

- B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Cores: One leg per phase.
- D. Enclosure: Ventilated, NEMA 250, Type 2.
  - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Transformer Enclosure Finish: Comply with NEMA 250.
  - 1. Finish Color: Gray.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
  - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
  - 2. Tested according to NEMA TP 2.
- J. Wall Brackets: Manufacturer's standard brackets.
- K. Fungus Proofing: Permanent fungicidal treatment for coil and core.
- L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

#### 2.4 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

#### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Brace wall-mounting transformers as specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

#### 3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

#### 3.4 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

# END OF SECTION 262200

SECTION 262416 - PANELBOARDS

# PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

# 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
- 4. Short-circuit current rating of panelboards and overcurrent protective devices.
- 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- 6. Include wiring diagrams for power, signal, and control wiring.
- 7. 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.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548
  "Vibration and Seismic Controls for Electrical Systems." Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field Quality-Control Reports:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Panelboard Schedules: For installation in panelboards.

#### 1.7 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.

#### 1.8 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. Keys: Two spares for each type of panelboard cabinet lock.
- 1.9 QUALITY ASSURANCE
  - A. Testing Agency Qualifications: Member company of NETA or an NRTL.
    - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
  - B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
  - C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
  - D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - E. Comply with NEMA PB 1.
  - F. Comply with NFPA 70.

### 1.10 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 NECA 407.

## 1.11 PROJECT 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 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
    - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.

### PANELBOARDS

2. Altitude not exceeding 6600 feet (2000 m).

### 1.12 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchorbolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

### 1.13 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  - 3. Finishes:
    - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.

- 4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top.
- D. Phase, Neutral, and Ground Buses:
  - 1. Material: Copper.
  - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Copper.
  - 2. Main and Neutral Lugs: Compression type.
  - 3. Ground Lugs and Bus-Configured Terminators: Compression type.
  - 4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
  - 5. IEM Inc
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Mains: Circuit breaker.
- G. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- H. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.

- b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
- c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
- d. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- D. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
- G. Install filler plates in unused spaces.
- H. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- I. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

## 3.4 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

# 3.5 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

## END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Snap switches and wall-box dimmers.
  - 3. Wall-switch occupancy sensors.
  - 4. Communications outlets.

## 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

# 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 2. Cord and Plug Sets: Match equipment requirements.

## 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packinglabel warnings and instruction manuals that include labeling conditions.

### PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

#### 2.2 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 application.
- B. Comply with NFPA 70.

## 2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
  - 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. Cooper; 5351 (single), CR5362 (duplex).
    - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5361 (single), 5362 (duplex).

#### 2.4 GFCI RECEPTACLES

- A. General Description:
  - 1. Straight blade, non-feed-through type.
  - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.

- 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper; VGF20.
    - b. Hubbell; GFR5352L.
    - c. Pass & Seymour; 2095.
    - d. Leviton; 7590.

### 2.5 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Single Pole:
    - b. Cooper; AH1221.
    - c. Hubbell; HBL1221.
    - d. Leviton; 1221-2.
    - e. Pass & Seymour; CSB20AC1.
    - f. Two Pole:
    - g. Cooper; AH1222.
    - h. Hubbell; HBL1222.
    - i. Leviton; 1222-2.
    - j. Pass & Seymour; CSB20AC2.
    - k. Three Way:
    - l. Cooper; AH1223.
    - m. Hubbell; HBL1223.
    - n. Leviton; 1223-2.
    - o. Pass & Seymour; CSB20AC3.
    - p. Four Way:
    - q. Cooper; AH1224.
    - r. Hubbell; HBL1224.
    - s. Leviton; 1224-2.
    - t. Pass & Seymour; CSB20AC4.

# 2.6 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.

- 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
- 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
- 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

## 2.7 FINISHES

- A. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: White.
- B. Wall Plate Color: For plastic covers, match device color.

### 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 meet provisions of NFPA 70, Article 300, without pigtails.
- 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 (152 mm) 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 down, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
  - 1. Install dimmers within terms of their listing.
  - 2. Verify that dimmers used for fan speed control are listed for that application.
  - 3. 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.

# 3.2 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.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Cartridge fuses rated 600-V ac and less for use in enclosed controllers.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

# 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

## 1.5 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Cooper Bussmann, Inc.
  - 2. Edison Fuse, Inc.
  - 3. Ferraz Shawmut, Inc.
  - 4. Littelfuse, Inc.

## 2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
  - 1. Motor Branch Circuits: Class RK1, time delay.
  - 2. Other Branch Circuits: Class RK1, time delay.

### 3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

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### 3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior lighting fixtures, lamps, and ballasts.
  - 2. Exit signs.
  - 3. Lighting fixture supports.
- B. Related Sections:
  - 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including occupancy sensors.
  - 2. Section 262726 "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

#### 1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. LER: Luminaire efficacy rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of lighting fixture including dimensions.
  - 2. Emergency lighting units including battery and charger.
  - 3. Ballast, including BF.

- 4. Energy-efficiency data.
- 5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
- 6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
  - a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
  - b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

### 1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.

### 1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

### 1.7 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

## PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.
- 2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS
  - A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
  - B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
  - C. LED Fixtures: Comply with UL 159, as well as LM79 and LM80.
    - 1. LED modules shall comply meet a minimum CRI of 85.
  - D. Metal Parts: Free of burrs and sharp corners and edges.
  - E. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
  - F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
  - G. Diffusers and Globes:
    - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
      - b. UV stabilized.
    - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
    - 1. Label shall include the following lamp and ballast characteristics:
      - a. "USE ONLY" and include specific lamp type.
      - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

- c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
- d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
- e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
- f. CCT and CRI for all luminaires.

# 2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. General Requirements for Electronic Ballasts:
  - 1. Comply with UL 935 and with ANSI C82.11.
  - 2. Designed for type and quantity of lamps served.
  - 3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
  - 4. Sound Rating: Class A.
  - 5. Total Harmonic Distortion Rating: Less than 10 percent.
  - 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  - 7. Operating Frequency: 42 kHz or higher.
  - 8. Lamp Current Crest Factor: 1.7 or less.
  - 9. BF: 0.88 or higher.
  - 10. Power Factor: 0.95 or higher.
  - 11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
- B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.
- C. Electronic Programmed-Start Ballasts for T5, T8, T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:
  - 1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
  - 2. Automatic lamp starting after lamp replacement.
- D. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
  - 1. Ballast Manufacturer Certification: Indicated by label.
- E. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
  - 1. Dimming Range: 100 to 5 percent of rated lamp lumens.
  - 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
  - 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
  - 4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.
- F. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

- 1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
  - a. High-Level Operation: 100 percent of rated lamp lumens.
  - b. Low-Level Operation: 30 percent of rated lamp lumens.
- 2. Ballast shall provide equal current to each lamp in each operating mode.
- 3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

## 2.4 DRIVERS FOR LED FIXTURES

- 1. Total Harmonic Distortion Rating: Less than 10 percent.
- 2. Transient Voltage Protection: IEEE C62.41, Category A or better.
- 3. Power Factor: 0.95 or higher.
- 4. Dimming Range: 100 to 10 percent of rated lamp lumens unless specified elsewhere.
- 5. Compatibility: Certified by manufacturer for use with specific dimming control system indicated.

#### 2.5 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  - 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
  - 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    - f. Integral Self-Test: Factory-installed electronic device automatically initiates coderequired test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

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### 2.6 FLUORESCENT LAMPS

- A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.
- B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours unless otherwise indicated.
- C. T5 rapid-start lamps, rated 28 W maximum, nominal length of 45.2 inches (1150 mm), 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3000 K, and average rated life of 20,000 hours unless otherwise indicated.
- D. T5HO rapid-start, high-output lamps, rated 54 W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated.
- E. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at three hours operation per start unless otherwise indicated.
  - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
  - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
  - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
  - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
  - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
  - 6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
  - 7. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

## 2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with 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 (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- E. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Lighting fixtures:
  - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
  - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
  - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

## 3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

## 3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

END OF SECTION 265100

# SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

### PART 1 - GENERAL

#### 1.1 DIVISION INCLUDES

- A. Head-end Software Video Surveillance
- B. Head-end Software Access & Security
- C. Cameras
  - 1. 1.3 MP (1280x720)
  - 2. 3.0 MP (1920x1024)
  - 3. 5.0 MP (2580x2048)
- D. Security controls, panels and monitoring devices
- E. Integration between access and video systems
- F. Integration between access and notification systems

### 1.2 RELATED WORK BY OTHERS

A. All rough-in data cabling to support the system will be provided by Division 27 – Communications Horizontal Cabling, unless otherwise noted on the drawings.

#### 1.3 RELATED REQUIREMENTS

- A. 280500 Common Work Results for CCTV and Security
- B. 281313 Access Control Applications
- C. 281316 Access Control Database
- D. 281319 Access Control Infrastructure
- E. 281326 Access Control Remote Devices
- F. 281333 Access Control Interfaces
- G. 281343 Access Control Identification Management Systems
- H. 281613 Intrusion Detection Control Panels

- I. 281619 Intrusion Detection Remote Devices
- J. 281633 Intrusion Detection Interfaces
- K. 282313 Video Surveillance Controls and Management Systems
- L. 282323 Video Surveillance Systems Infrastructure
- M. 282329 Video Surveillance Systems Remote Devices

#### 1.4 SUMMARY

#### A. LABOR AND MATERIALS

Unless otherwise provided in the Drawings and Specifications, the Contractor shall provide and pay for all labor, materials, equipment, tools, utilities, construction equipment and machinery, transportation and other facilities and services necessary for the proper execution, operation and completion of the Work.

### B. SPECIFICATION LANGUAGE

Specifications and notes are written in imperative and abbreviated form. Imperative language of the technical specifications is directed at the Contractor, unless specifically noted otherwise. Incomplete sentences shall be completed by inserting "shall", "shall be", "the Contractor shall", and similar mandatory phrases by inference. The words "shall be" shall be supplied by inference where a colon (:) is used within product specifications.

#### 1.5 DRAWINGS AND SPECIFICATIONS

- A. Contractor shall be provided three (3) sets of the Drawings and Specifications for their use. Additional sets, if requested by Contractor, shall be furnished to the Contractor for the actual cost of reproduction.
- B. Contractor shall carefully study the Drawings and Specifications, and shall at once report any error, unforeseen circumstances, inconsistency or omission he may discover.
- C. The Fern Ridge School District Project Manager shall be the interpreter of the requirements of the Drawings and Specifications, subject to the final approval of Fern Ridge School District. All interpretations and opinions of the Consultant shall be made in writing or in the form of drawings.

## 1.6 INTENT AND CORRELATION

- A. The intent of the Project Drawings and Specifications is to include all items necessary for the proper execution and completion of the Work.
- B. The Project Drawings and Specifications are complementary, and what is required by any one shall be as binding as if required by both.

### 1.7 REFERENCES

A. Submit the names and phone numbers of customers for at least three other projects of similar size and complexity using similar technologies.

# 1.8 DEFINITIONS

- A. Words that are in common use are used throughout the Drawings and Specifications, except:
- B. Words which have well-known technical or trade meanings are used in accordance with such recognized meanings.
- C. Whenever the following listed words and phrases are used, they shall be mutually understood to have the following respective meanings:
  - 1. The words "as indicated." means: as shown on the Drawings, and in accordance with the Specifications.
  - 2. The words "as required." means: as required to provide a complete and satisfactory Work in full conformance with the Drawings and Specifications.
  - 3. The word "Provide" means: furnish, install, connect, test and make ready for use.
  - 4. The word "Work": The Work is the completed construction required by the Drawings and Specifications, and includes all labor necessary to produce such construction, and all materials and equipment incorporated or to be incorporated in such construction.
  - 5. The word "Furnish" means: supply item as specified.

#### 1.9 ASSUMPTIONS

- A. It is commonly accepted that references to thin client shall connect to the server is via Microsoft<sup>TM</sup> Terminal Services and Microsoft<sup>TM</sup> Internet Explorer. In addition, it is assumed that all supplied systems components shall be compatible with the following first tier applications:
  - 1. Firefox
  - 2. Chrome
  - 3. Safari

# 1.10 CONTRACTOR DESIGN REQUIREMENTS

A. The Project Drawings represent the level of system design to be provided by Fern Ridge School District. Contractor shall provide all additional system design work required, including:

- 1. Point-to-point equipment hook-up information.
- 2. Equipment mounting details
- 3. Design of equipment cabinets
- 4. Other detailed design work required.
- B. Contractor's design shall conform to all applicable codes and ordinances. All electrical design, including the sizing and placement of conduit, raceways and conductors, shall be in accordance with NFPA 70: National Electrical Code<sup>®</sup> (*NEC*<sup>®</sup>), current version, unless local codes establish more stringent requirements.
- C. Contractor's design work is subject to review and approval by Fern Ridge School District's Project Manager.
- D. Contractor's design shall also include:
  - 1. Complete "as-built" documentation of all security systems, including documentation of all equipment, wiring, conduits, and raceways.
- E. Other Work as defined within the Project Drawings and Specifications.

#### 1.11 SUBMITTALS

- A. Product Data submittal shall only be required if the Contractor requests a substitution or a particular brand product is not specified or recommended
- B. Procedures
  - 1. Provide submittals to Owner.
  - 2. Submit three (3) copies of each submittal.
- C. Shop Drawings
  - 1. General Shop Drawings for the project as described elsewhere.
  - 2. Provide other Shop Drawings only if specifically requested by Owner.
- D. Provide Manufacturers Installation and Programming Instructions as requested in the various Specification Sections.

#### 1.12 PROJECT RECORD DRAWINGS

A. Definition: Project Record Drawings are drawings that completely record and document all aspects and features of the Work (also known as "as-built" drawings.)

- B. The purpose of Project Record Drawings is to provide factual information regarding all aspects of the Work, to enable future service, modifications, and additions to the Work.
- C. Project Record Drawings are an important element of this Work. Contractor shall accurately maintain Project Record Drawings throughout the course of this project and shall include documentation of all Work, including the documentation of equipment, wiring, conduits, and raceways that are to be reused in the Work.
- D. Owner's Representative shall furnish Contractor with two (2) sets of site plans for Contractor's use in preparing Project Record Drawings. One set shall be used as a working set; the other shall be used to prepare the final record set.
- E. Contractor shall maintain the working set of Project Record Drawings at the project site throughout the course of the Work. The working set shall be updated on a daily basis as the Work progresses.
- F. Project Record Drawings shall accurately show the physical placement of the following:
  - 1. Equipment and devices
  - 2. Junction and pull box locations.
  - 3. Interfaces to external equipment
  - 4. Connections to power and data circuits
- G. Project Record Drawings shall show the physical placement of each device and conduit or aerial center line, to be accurate to within one foot (1') of the nearest landmark. Where the site plan conflicts with actual conditions, Contractor shall amend site plan as required. Indicate exact description of conduit runs (above ground, two foot trench, along outside wall of building, etc.).
- H. Project Record Drawings shall show wire and cable runs, zone numbers, tamper circuit configuration, panel/circuit breaker numbers from which equipment is powered, and splice points. Such information may be shown on the site plans.
- I. Project Record Drawings shall be available for inspection by Owner on a daily basis. Incomplete or inaccurate Project Record Drawings may be cause for delay of Contractor's payment.
- J. Upon completion of Work, and prior to Final Acceptance, Contractor shall prepare and submit to Owner' a final record set of Project Record Drawings. This set shall consist of all data transferred from the working set, supplemented by Riser Diagrams and other information. The final record set of Project Record Drawings shall be drafted by a skilled draftsperson, under the supervision of Contractor. All final Project Record Drawings shall be provided to Owner.
- K. System Documentation

- 1. Definition: System Documentation is a complete collection of all installation, programming, operation, and maintenance manuals and work sheets relating to the equipment provided as part of the Work.
- 2. Contractor shall maintain a file of System Documentation at the project site throughout the course of the Work. Such file shall be updated with new information as equipment is received and installed.
- 3. Upon completion of Work, and prior to final Acceptance, Contractor shall prepare and submit to Fern Ridge School District Project Manager three (3) sets of System Documentation.
- L. Closeout Submittals
  - 1. Provide a set of as-built drawings and manuals to the Fern Ridge School District Project Manager
    - a. As-Built Drawings
    - b. Mounting Details
    - c. Product Data
    - d. Installation Manuals
    - e. Operating Manuals
    - f. Maintenance/Service Manuals
  - 2. Provide the Owner with all programming sheets, keys to the equipment cabinets, asbuilt drawings, operating manuals, maintenance/repair manuals, spare fuses, all programming sheets and keys to the equipment cabinets, tools for tamper-resistant enclosures and tools for manual resetting devices.

## 1.13 QUALITY ASSURANCE

- A. Qualifications of Contractor
  - 1. Contractor shall be an installation and service contractor regularly engaged in the sale, installation, maintenance and service of access control systems.
  - 2. Contractor shall have three years' experience with the installation, start-up and programming of systems of a similar size and complexity to the one proposed.
  - 3. Contractor shall be a factory authorized dealer of the system proposed.
- B. Supervision of Work
  - 1. Contractor shall employ a competent Project Manager to be in responsible charge of the Work and be on project site during the execution of the Work.
  - 2. Contractor's Foreman shall be a regular employee, principle, or officer of Contractor, who is thoroughly experienced in projects of a similar size and type. Contractor shall not use contract employees or Subcontractors as Foremen.

- C. Qualifications of Technicians
  - 1. All electronic systems Work shall be performed by electronic technicians thoroughly trained in the installation and service of specialty low-voltage electronic systems.
  - 2. Journeyman electricians may be used to install conduit, raceways, wiring, and the like, provided that final termination, hook-up, programming, and testing is performed by a qualified electronic technician, and that all such Work is supervised by the Contractor's Foreman.
  - 3. All incidental Work, such as cutting and patching, lock hardware installation, painting, carpentry, and the like, shall be accomplished by skilled craftsperson regularly engaged in such type of work. All such Work shall comply with the highest standards applicable to that respective industry or craft.
- D. Subcontractors
  - 1. Definition: A Subcontractor is a person or entity who has a direct contract with the Contractor to perform any of the Work at the site.
  - 2. Use of any Subcontractor is subject to the approval of Owner. The Contractor shall identify all Subcontractors on the Bid Form. The Contractor shall make no substitution for any Subcontractor previously selected without approval from Owner.
  - 3. Contractor's Foreman shall be on the project site daily during all periods when Subcontractors are performing any of the Work. Contractor's Foreman shall be in responsible charge of all Work, including any Work being performed by Subcontractors.
  - 4. By an appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Drawings and Specifications, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these documents, assumes toward Owner.
- E. Supervision and Construction Procedures
  - 1. The Contractor shall supervise and direct the Work, using their best skill and attention. Contractor is solely responsible for all construction means, methods, and techniques.
  - 2. The Contractor shall employ a competent foreman who shall be in attendance at the project site during the progress of the Work. The foreman shall represent the Contractor and all communications given to the foreman shall be as binding as if given to the Contractor.
- F. Regulatory Requirements

- 1. All Work is to conform to all building, fire, and electrical codes and ordinances. In case of conflict between the Drawings/Specifications and codes, the codes shall govern.
- 2. Contractor shall secure and pay for all licenses, permits, plan reviews, engineering certifications, and inspections required by regulatory agencies. Contractor shall prepare, at Contractor's expense, any documents, including drawings that may be required by regulatory agencies.
- G. Permits
  - 1. The Contractor shall make application for and obtain any and all permits required.

### 1.14 PROJECT/SITE CONDITIONS

- A. Environmental Conditions
  - 1. Power: Electrical power will be supplied by General Contractor to the extent that the usage is compatible with available facilities in the vicinity of the work.
  - 2. Parking: General Contractor reserves the right to limit or restrict Contractor parking based upon the daily requirements of the other contractors on site.
  - 3. Dust Control: Make provisions to control all dust, dirt, and foreign material caused by the performance of the Work.
  - 4. Notify General Contractor immediately of any damage or possible damage to any other equipment.
- B. Clean-Up
  - 1. Contractor shall clean-up, on a daily basis as the Work progresses, all dirt, dust and debris caused by Contractor's operations. Clean-up shall be completed by the end of each workday to the satisfaction of Owner's on-site representative.
  - 2. In the event that Contractor fails to clean-up, General Contractor may elect to have clean-up performed by others, with the costs of such clean-up being charged to the Contractor.
- C. Construction Aids
  - 1. Definition: Construction Aids are facilities and equipment required by personnel to facilitate the execution of the Work. Construction Aids include scaffolds, staging, ladders, platforms, hoists, cranes, lifts, trenchers, core drillers, protective equipment, and other such facilities and equipment.
  - 2. Contractor shall provide all Construction Aids required in the execution of the Work. Construction Aids that are the property of Fern Ridge School District or other contractors shall not be used without permission.

- 3. Storage of Construction Aids shall be coordinated with Fern Ridge School District's on-site representative.
- D. Safety
  - 1. The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work.
  - 2. Contractor shall comply with all local, state, and federal regulations and laws for the safety of the work place.

#### 1.15 SEQUENCING

- A. Description
  - 1. This implementation plan describes the general approach that shall be followed in order to minimize the time for the access control systems to be operational.
- B. Approach
  - 1. Contractor shall plan and schedule all work in such a sequence as to minimize the time before the system is operational. The following is a suggested work sequence:
  - 2. Order all equipment needed and notify any subcontractors to schedule their participation.
  - 3. Perform all system layout work.
  - 4. Insure there are an adequate number of power receptacles available to operate all security equipment and coordinate with Fern Ridge School District as to where power is available.
  - 5. Provide shop drawings to verify location of all equipment, conduit runs, power connections, etc. Submit shop drawings to Fern Ridge School District Project Manager.
  - 6. Coordinate with Fern Ridge School District to provide space in each building's Communications Room for mounting of processors.
  - 7. Provide training on how to fill out the programming sheets for access levels.
  - 8. Prepare and pre-test all equipment to the greatest extent possible.
  - 9. Install all equipment.
  - 10. Provide training on the programming other various options.
  - 11. Test and inspect all systems.
  - 12. Perform all other Work as required.

- 13. Perform the Acceptance Test.
- 14. Provide training.
- 15. Provide as-built drawings.

#### 1.16 SCHEDULING

A. The Contractor, within five (5) days after being awarded the contract, shall prepare and submit for Fern Ridge School District's information, an estimated progress schedule for the Work. The progress schedule shall be related to the entire project, and shall indicate start and completion dates.

#### 1.17 WARRANTY

- A. Contractor warrants that all Work furnished (material and labor) under this Contract will be of good quality, free from faults and defects, and in conformance with the Project Drawings and Specifications.
- B. Contractor shall provide a parts and labor guarantee on all Work. Unless otherwise specified herein, Contractor's guarantee shall be for a period of two (2) years from date of Acceptance, except where any specific guarantees from a supplier or equipment manufacturer extends for a longer time.
- C. Contractor's guarantee shall cover all costs associated with troubleshooting, repair, and replacement of defective Work, including costs of labor, transportation, lodging, materials, and equipment.
- D. Guarantee shall not cover any damage to material or equipment caused by accident, misuse, unauthorized modification or repair by Fern Ridge School District, or acts of God.
- E. Contractor shall promptly respond to Fern Ridge School District's requests for service during the guarantee period. Contractor shall provide repair service as soon as reasonably possible upon request from Fern Ridge School District, but in no case shall service response exceed 24 hours from time of request.

#### 1.18 OWNER'S INSTRUCTIONS

- A. Coordination with Fern Ridge School District
  - 1. Contractor shall closely schedule and coordinate their activities with designated Fern Ridge School District representatives.
  - 2. Contractor shall provide Fern Ridge School District's Project Manager with a work plan on a weekly basis. Such work plan will describe locations of intended activities, types of activities, and potential conflicts to facility operations.
- B. Fern Ridge School District's Representatives:

Darren Herrick – Northwest Information Services Telephone (503) 830-6305 Darren.herrick@northwestinformationservices.com

- C. **Fern Ridge School District's Right to Carry out the Work** If the Contractor defaults or neglects to carry out the Work in accordance with the Project Drawings and Specifications and fails within seven days after receipt of written notice from Fern Ridge School District to commence and continue correction of such default or neglect with diligence and promptness, Fern Ridge School District may, after seven days following receipt of an additional written notice and without prejudice to any other remedy Fern Ridge School District may have, make good such deficiencies. In such case, an appropriate Change Order shall be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies.
- D. **Minor Changes in the Work** Fern Ridge School District shall have the authority to order minor changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time and not inconsistent with the intent of the Project Drawing and Specifications. Such changes shall be provided by written order.

## 1.19 INSPECTIONS

- A. After all Work is completed, and prior to requesting the Acceptance test, Contractor shall conduct a final inspection, and pre-test all equipment and system features. Contractor shall correct any deficiencies discovered as the result of the inspection and pre-test.
- B. Contractor shall submit a request for the Acceptance test in writing to the Fern Ridge School District Project Manager, no less than fourteen days prior to the requested test date. The request for Acceptance test shall be accompanied by a certification from Contractor that all Work is complete and has been pre-tested, and that all corrections have been made.
- C. During Acceptance test, Contractor shall demonstrate all equipment and system features to Fern Ridge School District. Contractor shall remove covers, open wiring connections, operate equipment, and perform other reasonable work as requested by Fern Ridge School District.
- D. Any portions of the Work found to be deficient or not in compliance with the Project Drawing and Specifications will be rejected. Fern Ridge School District Project Manager will prepare a list of any such deficiencies observed during the Acceptance test. Contractor shall promptly correct all deficiencies. Upon correction of deficiencies, Contractor shall submit a request in writing to Fern Ridge School District Project Manager for another Acceptance Test.
- E. If, at the conclusion of the Acceptance Test, all Work is found to be acceptable and in compliance with the Project Drawings and Specifications, Fern Ridge School District Project Manager will issue a letter of Acceptance to Contractor and Fern Ridge School District.

## 1.20 MAINTENANCE

- A. Provide full procedures for all database back-ups.
- B. Provide full procedures for server/workstation hard drive maintenance, such as defrag, etc.
- C. Provide full procedures for maintaining physical and software firewalls.
- D. Provide full procedures for upgrading software.
- E. Provide full procedures for any other tasks that must be performed to ensure the warranty remains intact.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. All products shall be new and unused, and shall be of manufacturer's current and standard production.
- B. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.
- D. Product Availability
  - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into their proposed Contract Time.
  - 2. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify their ability to procure the products specified prior to submitting a proposal.

#### PART 3 - EXECUTION

#### 3.1 ACCEPTABLE INSTALLERS

- A. The system shall only be provided by Contractors who are factory authorized to install, service and maintain the system by the access control manufacturer.
- B. The Contractor must be a factory authorized dealer with the proposed manufacturer.
- C. The Contractor's installers and technicians shall also be factory trained and certified to perform such tasks.

### 3.2 EXAMINATION

- A. The Contractor shall be required to visit the installation site prior to bidding the job.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

### 3.3 PREPARATION

- A. The Contractor shall order all required parts and equipment upon notification of award of the Work.
- B. The Contractor shall bench test all equipment prior to delivery to the job site.
- C. The Contractor shall verify the availability of power where required. If a new source of power is required, a licensed electrician shall be used to install it.
- D. The Contractor shall arrange for obtaining all programming information including access times, free access times, door groups, operator levels, etc.

### 3.4 INSTALLATION

- A. The Contractor shall coordinate installation and camera licensing to facilitate the operation of this system with the Video Surveillance Control System. This system, Milestone Enterprise, shall be installed on a Window Server 2012 server provided by the Contractor. The Contractor shall coordinate with the Fern Ridge School District's IT Department when connecting to their network.
- B. The Contractor shall carefully follow the instructions in the manufacturers' Installation Manual to insure all steps have been taken to provide a reliable, easy to operate system.
- C. Perform all Work as indicated in the Drawings and Specifications.
- D. All communications cables shall be kept away from power circuits.
- E. The Contractor shall also execute adequate testing of the system to insure proper operation.
- F. The Contractor shall provide adequate training of the system users to insure adequate understanding to prevent operating errors.

#### 3.5 WORKMANSHIP

- A. Comply with National Electric Code<sup>®</sup> as well as recognized industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform Work with persons experienced and qualified to produce workmanship specified.
- C. Maintain quality control over suppliers and Subcontractors.
D. Quality of workmanship is considered important. Fern Ridge School District Project Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.

### 3.6 EQUIPMENT PRE-TEST

A. All equipment shall be bench tested prior to delivery to job site and prior to installation. Bench test all equipment per manufacturer's installation instructions.

#### 3.7 GROUNDING

A. Provide earth-grounding of equipment as required by equipment manufacturer. Earth ground shall be connected to ground rod or approved building system ground. Electrical or telephone ground connections shall not be used as earth grounds. Connections to mounting posts or building structural steel shall not be used as earth grounds.

### 3.8 POWER TO SECURITY EQUIPMENT

- A. Power all equipment from 120 VAC circuit dedicated for security use, except as noted. Mark all panel circuit breakers with labels worded "Security Equipment Do Not Operate", or equivalent.
- B. All plug-in transformers shall be located at the security control panels. Secure all low-voltage plug-in transformers to outlet with screw or strap. Clearly label all transformers to identify purpose and use.

#### 3.9 CUTTING AND PATCHING

A. The Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the Work.

#### 3.10 PLYWOOD BACKING

A. Install the processor(s), power supplies, and all other related equipment on a plywood backboard (installed by others) in the nearest Telecommunication Room.

#### 3.11 FIELD QUALITY CONTROL

- A. Upon reaching Substantial Completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify Fern Ridge School District of your readiness to perform the formal Test & Inspection of the complete system.
- B. Submit the Record Drawings (as-builts) to Fern Ridge School District for review prior to inspection.

- C. During the formal Test & Inspection (Commissioning) of the system, have personnel available with tools and equipment to remove devices from their mounts to inspect wiring connections. Provide wiring diagrams and labeling charts to properly identify all wiring.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify Fern Ridge School District when ready to perform a re-inspection of the installation.

#### 3.12 MANUFACTURER PROFESSIONAL SERVICES

- A. Contractor shall coordinate with the manufacturer to provide the manufacturer's professional services team to assist the Owner in coordinating the interfaces between the security management system and other on-site systems as necessary.
- B. Professional Services personnel shall be employed by the manufacturer of the security management system and shall be thoroughly knowledgeable of the security management system applications.
- C. Professional Services personnel shall be on-site and available to meet with Owner's representatives for a period of not less than two consecutive days. On-site visit shall be scheduled at the convenience of the Owner.

## END OF SECTION 280500

# SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

#### A. Section Includes:

- 1. Fire-alarm control unit.
- 2. Manual fire-alarm boxes.
- 3. System smoke detectors.
- 4. Heat detectors.
- 5. Notification appliances.
- 6. Device guards.
- 7. Magnetic door holders.
- 8. Remote annunciator.
- 9. Addressable interface device.
- 10. Digital alarm communicator transmitter.
- 11. Network communications.
- 12. System printer.
- 13. Fire alarm wire and cable

## 1.3 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. HLI: High Level Interface.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. PC: Personal computer.

# 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
  - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, and electrical characteristics.

#### DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

- B. Shop Drawings: For fire-alarm system.
  - 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
  - 2. Include plans, elevations, sections, details, and attachments to other work.
  - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
  - 4. Detail assembly and support requirements.
  - 5. Include voltage drop calculations for notification-appliance circuits.
  - 6. Include battery-size calculations.
  - 7. Include input/output matrix.
  - 8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
  - 9. Include performance parameters and installation details for each detector.
  - 10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  - 11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    - b. Show field wiring required for HVAC unit shutdown on alarm.
    - c. Locate detectors according to manufacturer's written recommendations.
    - d. Show air-sampling detector pipe routing.
  - 12. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
  - 13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- C. General Submittal Requirements:
  - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
  - 2. Shop Drawings shall be prepared by persons with the following qualifications:
    - a. Trained and certified by manufacturer in fire-alarm system design.
    - b. NICET-certified, fire-alarm technician; Level III minimum.
    - c. Licensed or certified by authorities having jurisdiction.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
- 1.6 Sample Warranty: For special warranty.

## 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
    - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
    - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
    - d. Riser diagram.
    - e. Device addresses.
    - f. Record copy of site-specific software.
    - g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
      - 1) Equipment tested.
      - 2) Frequency of testing of installed components.
      - 3) Frequency of inspection of installed components.
      - 4) Requirements and recommendations related to results of maintenance.
      - 5) Manufacturer's user training manuals.
    - h. Manufacturer's required maintenance related to system warranty requirements.
    - i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  - 3. Device address list.

4. Printout of software application and graphic screens.

#### 1.8 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. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
  - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
  - 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
  - 4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
  - 5. Keys and Tools: One extra set for access to locked or tamperproofed components.
  - 6. Audible and Visual Notification Appliances: One of each type installed.
  - 7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

# 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
- C. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.
- D. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

- 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
- 2. Warranty Period: Five years from date of Substantial Completion.

# PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified and FM Global-placarded addressable system, with multiplexed signal transmission and voice/strobe evacuation.
- B. Automatic sensitivity control of certain smoke detectors.
- C. All components provided shall be listed for use with the selected system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
  - 1. Manual stations.
  - 2. Heat detectors.
  - 3. Smoke detectors.
  - 4. Duct smoke detectors.
  - 5. Automatic sprinkler system water flow.
  - 6. Preaction system.
  - 7. Fire-extinguishing system operation.
  - 8. Fire standpipe system.
  - 9. Dry system pressure flow switch.
- B. Fire-alarm signal shall initiate the following actions:
  - 1. Continuously operate alarm notification appliances, including voice evacuation notices.
  - 2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
  - 3. Transmit an alarm signal to the remote alarm receiving station.
  - 4. Unlock electric door locks in designated egress paths.
  - 5. Release fire and smoke doors held open by magnetic door holders.
  - 6. Activate voice/alarm communication system.
  - 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
  - 8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
  - 9. Activate preaction system.
  - 10. Recall elevators to primary or alternate recall floors.
  - 11. Activate elevator power shunt trip.
  - 12. Activate emergency lighting control.

- 13. Activate emergency shutoffs for gas and fuel supplies.
- 14. Record events in the system memory.
- 15. Record events by the system printer.
- 16. Indicate device in alarm on the graphic annunciator.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
  - 1. Valve supervisory switch.
  - 2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
  - 3. Elevator shunt-trip supervision.
  - 4. User disabling of zones or individual devices.
  - 5. Loss of communication with any panel on the network.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
  - 1. Open circuits, shorts, and grounds in designated circuits.
  - 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  - 3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
  - 4. Loss of primary power at fire-alarm control unit.
  - 5. Ground or a single break in internal circuits of fire-alarm control unit.
  - 6. Abnormal ac voltage at fire-alarm control unit.
  - 7. Break in standby battery circuitry.
  - 8. Failure of battery charging.
  - 9. Abnormal position of any switch at fire-alarm control unit or annunciator.
  - 10. Voice signal amplifier failure.
- E. System Supervisory Signal Actions:
  - 1. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
  - 2. Record the event on system printer.
  - 3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
  - 4. Transmit system status to building management system.
  - 5. Display system status on graphic annunciator.

### 2.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

## 2.4 FIRE-ALARM CONTROL UNIT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. GAMEWELL.
  - 2. GE UTC Fire & Security; A United Technologies Company.
  - 3. Notifier.
  - 4. Silent Knight.
  - 5. Siemens Industry, Inc.; Fire Safety Division.
  - 6. Tyco
- B. General Requirements for Fire-Alarm Control Unit:
  - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
    - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    - b. Include a real-time clock for time annotation of events on the event recorder and printer.
    - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    - d. The FACP shall be listed for connection to a central-station signaling system service.
    - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
  - 2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
  - 3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
  - 1. Annunciator and Display: Liquid-crystal type, three line(s) of 40 characters, minimum.
  - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
  - 1. Pathway Class Designations: NFPA 72, Class A.
  - 2. Pathway Survivability: Level 1.

- 3. Install no more than 50 addressable devices on each signaling-line circuit.
- 4. Serial Interfaces:
  - a. One dedicated RS 485 port for central-station operation using point ID DACT.
  - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
  - c. One USB or RS 232 port for PC configuration.
  - d. One RS 232 port for voice evacuation interface.
- E. Smoke-Alarm Verification:
  - 1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
  - 2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
  - 3. Record events by the system printer.
  - 4. Sound general alarm if the alarm is verified.
  - 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- F. Notification-Appliance Circuit:
  - 1. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.
- H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- J. Voice/Alarm Signaling Service: Central emergency communication system with preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
  - 1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
    - a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
    - b. Programmable tone and message sequence selection.
    - c. Standard digitally recorded messages for "Evacuation" and "All Clear."

- d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.
- 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
- 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- K. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- L. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals and supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
  - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the powersupply module rating.
- M. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
  - 1. Batteries: Sealed lead calcium.
- N. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

# 2.5 MANUAL FIRE-ALARM BOXES

- 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. GAMEWELL.
  - 2. GE UTC Fire & Security; A United Technologies Company.
  - 3. Notifier.
  - 4. Silent Knight.
  - 5. System Sensor.
  - 6. Siemens Industry, Inc.; Fire Safety Division.
  - 7. Tyco
- B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show

visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

- 1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
- 2. Station Reset: Key- or wrench-operated switch.
- 3. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

## 2.6 SYSTEM SMOKE DETECTORS

- 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. GAMEWELL.
  - 2. GE UTC Fire & Security; A United Technologies Company.
  - 3. Notifier.
  - 4. Silent Knight.
  - 5. Siemens Industry, Inc.; Fire Safety Division.
  - 6. Tyco
- B. General Requirements for System Smoke Detectors:
  - 1. Comply with UL 268; operating at 24-V dc, nominal.
  - 2. Detectors shall be four-wire type.
  - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
  - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  - 6. Integral Visual-Indicating Light: LED type, indicating detector has operated and poweron status.
  - 7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    - a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    - b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
    - c. Multiple levels of detection sensitivity for each sensor.
    - d. Sensitivity levels based on time of day.
- C. Photoelectric Smoke Detectors:

- 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
- 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).
- D. Ionization Smoke Detector:
  - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.
    - e. Sensor range (normal, dirty, etc.).
- E. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
  - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.
    - e. Sensor range (normal, dirty, etc.).
  - 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
  - 4. Each sensor shall have multiple levels of detection sensitivity.
  - 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
  - 6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

## 2.7 HEAT DETECTORS

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. GAMEWELL.
- 2. GE UTC Fire & Security; A United Technologies Company.
- 3. Notifier.
- 4. Silent Knight.
- 5. System Sensor.
- 6. Siemens Industry, Inc.; Fire Safety Division.
- 7. Tyco
- B. General Requirements for Heat Detectors: Comply with UL 521.
  - 1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
  - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- D. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
  - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

# 2.8 NOTIFICATION APPLIANCES

- 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. Cooper Wheelock.
  - 2. GE UTC Fire & Security; A United Technologies Company.
  - 3. Notifier.
  - 4. System Sensor.
  - 5. Siemens Industry, Inc.; Fire Safety Division.
  - 6. Tyco
- B. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
  - 1. Combination Devices: Factory-integrated audible and visible devices in a singlemounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
- D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

- E. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
  - 1. Rated Light Output:
    - a. 15/30/75/110 cd, selectable in the field.
  - 2. Mounting: Wall mounted unless otherwise indicated.
  - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
  - 4. Flashing shall be in a temporal pattern, synchronized with other units.
  - 5. Strobe Leads: Factory connected to screw terminals.
  - 6. Mounting Faceplate: Factory finished, red.
- F. Voice/Tone Notification Appliances:
  - 1. Comply with UL 1480.
  - 2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
  - 3. High-Range Units: Rated 2 to 15 W.
  - 4. Low-Range Units: Rated 1 to 2 W.
  - 5. Mounting: Semirecessed.
  - 6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

## 2.9 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
  - 1. Electromagnets: Require no more than 3 W to develop 25-lbf (111-N) holding force.
  - 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
  - 3. Rating: 120-V ac.
- B. Material and Finish: Match door hardware.

# 2.10 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
  - 1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

# 2.11 ADDRESSABLE INTERFACE DEVICE

### A. General:

- 1. Include address-setting means on the module.
- 2. Store an internal identifying code for control panel use to identify the module type.
- 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.
  - 1. Allow the control panel to switch the relay contacts on command.
  - 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
  - 1. Operate notification devices.
  - 2. Operate solenoids for use in sprinkler service.

## 2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from firealarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
  - 1. Verification that both telephone lines are available.
  - 2. Programming device.
  - 3. LED display.
  - 4. Manual test report function and manual transmission clear indication.

- 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
  - 1. Address of the alarm-initiating device.
  - 2. Address of the supervisory signal.
  - 3. Address of the trouble-initiating device.
  - 4. Loss of ac supply.
  - 5. Loss of power.
  - 6. Low battery.
  - 7. Abnormal test signal.
  - 8. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

#### 2.13 NETWORK COMMUNICATIONS

- A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.
- B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.
- C. Provide integration gateway using BACnet for connection to building automation system.

#### 2.14 SYSTEM PRINTER

A. Printer shall be listed and labeled as an integral part of fire-alarm system.

#### 2.15 FIRE ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Comtran Corporation.
  - 2. Draka Cableteq USA.
  - 3. Genesis Cable Products; Honeywell International, Inc.
  - 4. Rockbestos-Suprenant Cable Corp.
  - 5. West Penn Wire; a brand of Belden Inc.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
  - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
  - 2. Line-Voltage Circuits: No. 12 AWG, minimum.

### 2.16 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
  - 1. Factory fabricated and furnished by device manufacturer.
  - 2. Finish: Paint of color to match the protected device.

# PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
  - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
  - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.
  - 1. Comply with requirements for seismic-restraint devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

- C. Manual Fire-Alarm Boxes:
  - 1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
  - 2. Mount manual fire-alarm box on a background of a contrasting color.
  - 3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Smoke- or Heat-Detector Spacing:
  - 1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
  - 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
  - 3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
  - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
  - 5. HVAC: Locate detectors not closer than 60 inches (1520 mm) from air-supply diffuser or return-air opening.
  - 6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
- E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.
  - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- G. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.
- H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- I. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- J. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

L. Device Location-Indicating Lights: Locate in public space near the device they monitor.

#### 3.3 PATHWAYS

- A. Pathways shall be installed in EMT.
- B. Exposed EMT shall be painted red enamel.

#### 3.4 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
  - 2. Smoke dampers in air ducts of designated HVAC duct systems.
  - 3. Magnetically held-open doors.
  - 4. Electronically locked doors and access gates.
  - 5. Alarm-initiating connection to elevator recall system and components.
  - 6. Alarm-initiating connection to activate emergency lighting control.
  - 7. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
  - 8. Supervisory connections at valve supervisory switches.
  - 9. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
  - 10. Supervisory connections at elevator shunt-trip breaker.
  - 11. Data communication circuits for connection to building management system.
  - 12. Supervisory connections at fire-extinguisher locations.

#### 3.5 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceway and Boxes for Electrical Systems."
  - 1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and

back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- F. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

## 3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

## 3.7 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

# 3.8 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

- b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
- 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
- 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
- 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
- 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

## 3.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

### 3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

SECTION 312000 - EARTH MOVING

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Preparing subgrades.
  - 2. Excavating and backfilling for buildings and structures.
  - 3. Drainage course for concrete slabs-on-grade.
  - 4. Base course for concrete pavements.
  - 5. Base course for asphalt paving.
  - 6. Excavating and backfilling for utility trenches.
  - 7. Drainage fill for infiltration facilities.

#### 1.2 SUBMITTALS

- A. Product Data.
- B. Aggregate Sieve Analysis.

#### 1.3 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
  - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subbase course, or subgrade, and concrete, or hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
  - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional

excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

- 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subgrade: Surface or elevation remaining after completing excavation, or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- J. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- K. Drainage Fill: Free draining, open-graded aggregate course used to support pervious pavement or in drainage zones in flow-through planters, vegetated stormwater facilities and infiltration galleries.
- L. Unified Soil Classification System:
  - 1. GW: Well-graded gravels; gravel/sand mixtures with little or no fines.
  - 2. GP: Poorly-graded gravels; gravel/sand mixtures with little or no fines.
  - 3. GM: Silty gravels; poorly-graded gravel/sand/silt mixtures.
  - 4. GC: Clayey gravels; poorly-graded gravel/sand/clay mixtures.
  - 5. SW: Well-graded sands' gravelly sands with little or no fines.
  - 6. SP: Poorly-graded sands; gravelly sands with little or no fines.
  - 7. SM: Silty sands; poorly, graded- sand/gravel/silt mixtures.
  - 8. SC: Clayey sands; poorly-graded sand/gravel/clay mixtures.
  - 9. ML: Inorganic silts; sandy, gravelly, or clayey silts.
  - 10. CL: Lean clays; inorganic, gravelly, sandy, or silty, low to medium-plasticity clays.
  - 11. OL: Organic, low-plasticity clays and silts.
  - 12. MH: Inorganic, elastic silts; sandy, gravelly or clayey elastic silts
  - 13. CH: Fat clays; high-plasticity, inorganic clays.
  - 14. OH: Organic, medium to high-plasticity clays and silts
  - 15. PT: Peat, humus, hydric soils with high organic content.

### 1.4 PROJECT CONDITIONS

- A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect, and then only after arranging to provide temporary utility services according to requirements indicated.

- C. Site Information: Research public utility records and verify existing utility locations prior to ordering any material. Notify the Architect immediately if any discrepancies are found in the project survey.
- D. See Geotechnical report titled Geotechnical Site Investigation and Recommendations by K & A Engineering dated August 28, 2014, for additional information and requirements.

### PART 2 - PRODUCTS

#### 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Base Course: Use Oregon Standard Specifications for Construction 1-inch-0-inch or 3/4-inch-0-inch BASE AGGREGATE.
- E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 3-inch sieve and not more than 12 percent passing a No. 200sieve.
- F. Bedding Course: Use Oregon Standard Specifications for Construction 3/4-inch-0-inch BASE AGGREGATE.
- G. Drainage Course: Narrowly graded mixture of washed, crushed stone, or crushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- H. Backfill and Fill:
  - 1. Satisfactory soil materials,
  - 2. Initial trench backfill: Use Oregon Standard Specifications for Construction 3/4-inch-0-inch BASE AGGREGATE.
- I. Drainage Fill: Angular, granular material with a maximum particle size of 2 inches and shall meet Oregon Standard Specification 00430.11. The material shall be free of roots, organic material, and other unsuitable materials; have less than 2 percent passing the No. 200 sieve (washed analysis); and have at least two mechanically fractured faces.

### 2.2 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction or as follows:
  - 1. Red: Electric.
  - 2. Yellow: Gas, oil, steam, and dangerous materials.
  - 3. Orange: Telephone and other communications.
  - 4. Blue: Water systems.
  - 5. Green: Sewer systems.
- B. Tracer Wire: 12 AWG minimum solid copper insulated High Molecular Weight Polyethylene (HMW PE) tracer wire or approved equal. The tracer wire insulation shall be green for sewer pipe and blue for waterlines and be a minimum of 45 mil. thick. Joints or splices shall be waterproof. The wire shall be rated for 30 Volt.
- C. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
  - 1. Grab Tensile Strength: 110 lbf; ASTM D 4632.
  - 2. Tear Strength: 40 lbf; ASTM D 4533.
  - 3. Puncture Strength: 220 lbf; ASTM D 4833.
  - 4. Apparent Opening Size: No. 40; ASTM D 4751.
  - 5. Permativity (minimum):  $.5 \text{ sec}^{-1}$ ; ASTM D 4491.
- D. Separation Fabric: Woven geotextile, specifically manufactured as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
  - 1. Grab Tensile Strength: 180 lbf; ASTM D 4632.
  - 2. Tear Strength: 68 lbf; ASTM D 4533.
  - 3. Puncture Strength: 371 lbf; ASTM D 4833.
  - 4. Apparent opening size: No. 30; ASTM D 4751.

## PART 3 - EXECUTION

## 3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations. Provide protective insulating materials as necessary.

- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."
- C. Protect and maintain erosion and sedimentation controls during earth moving operations.
- D. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- F. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
- G. Protect all areas designated to be infiltration facilities from foot or equipment traffic and surface water runoff. Do not use proposed infiltration facilities to dispose of surface water runoff during construction. Under no circumstances shall material and equipment be stored on top of the installation area. Contractor shall not backfill facility until Engineer has inspected it and signed off.
- H. Protect all areas designated to receive pervious pavers or pervious pavement from excessive compaction.

## 3.2 EXPLOSIVES

1. Explosives: Do not use explosives.

# 3.3 EXCAVATION

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions without prior approval by the Architect.
  - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

### 3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

# 3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

## 3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
  - 1. Clearance: 6 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade and bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
  - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course. Hand excavate for bell of pipes.
  - 2. Excavate utility structures to provide 6 inches clearance (enlarge as needed) to allow for compaction of backfill material.

#### 3.7 SUBGRADE INSPECTION

- A. Proof-roll subgrade with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding under the supervision of the geotechnical engineer. Do not proof-roll wet or saturated subgrades.
- B. Soft pockets and areas of excess yielding that have been identified shall be scarified and moistened or aerated, or removed and replaced with suitable soil materials to the depth required. Re-compact and retest until specified compaction is obtained.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

#### 3.8 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
  - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

### 3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.10 BACKFILLS AND FILLS

- A. Backfill: Place and compact backfill in excavations promptly, but not before completing the following:
  - 1. Construction below finish grade including, where applicable, dampproofing, waterproofing and perimeter insulation.
  - 2. Surveying locations of underground utilities for record documents.
  - 3. Inspecting and testing underground utilities.
  - 4. Removing concrete formwork.
  - 5. Removing trash and debris.
  - 6. Removing temporary shoring and bracing, and sheeting.
  - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

# 3.11 UTILITY TRENCH BEDDING

- A. Place bedding on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints and barrels of pipes; and for joints, fittings and bodies of conduits.

### 3.12 UTILITY TRENCH BACKFILL

A. Trenches under Footings: Backfill trenches excavated under footings with satisfactory soil or approved backfill to within 18 inches from the bottom of footings elevation; fill remaining trench excavation with concrete up to the elevation of bottom of footings. Concrete is specified in "Cast-in-Place Concrete."

- B. Place and compact initial trench backfill material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
  - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- C. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- D. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
- E. Install tracer wire in a continuous fashion above the utility in such a manner as to be able to properly trace utility lines without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire. Bring tracer wire to the surface at every box, vault, drainage structure, or manhole.

#### 3.13 DRAINAGE FILL

- A. Compaction of the native soil subgrade should be limited in order to prevent a reduction in the permeability of the soil.
  - 1. Where erosion of subgrade has caused accumulation of fine materials and/or surface ponding, this material shall be removed with light equipment and underlying soils scarified to a minimum depth of 3 inches with a York rake or equivalent and light tractor.
  - 2. Where subgrade has been compacted due to construction traffic, subgrade shall be scarified or removed to a depth sufficient to match the naturally occurring insitu state. Add additional base course material to meet design grades at no cost to the owner.
  - 3. Bring subgrade of base course to line, grade, and elevations indicated. Fill and lightly regrade any areas damaged by erosion, ponding, or traffic compaction before the placing of stone.
- B. Place drainage geotextile over prepared subgrade, overlapping ends and edges at least 12 inches. Secure in place to prevent wrinkling.
- C. Place drainage fill and compact by tamping with a plate vibrator, and screed to depth indicated. For drainage fill that exceeds 8 inches in compacted thickness, place fill in layers of equal thickness, with no compacted layer more than 8 inches or less than 4 inches thick.
- D. Place drainage geotextile over compacted drainage fill, overlapping ends and edges at least 12 inches.
- 3.14 SOIL FILL
  - A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
  - B. Place and compact fill material in layers to required elevations as follows:

- 1. Under grass and planted areas, use satisfactory soil material.
- 2. Under walks and pavements, use base course.
- 3. Under steps and ramps, use base course.
- 4. Under building slabs, use drainage course.
- 5. Under footings and foundations, use drainage course.
- 6. Under and around utility structures, use engineered fill.

#### 3.15 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 3 percent and is too wet to compact to specified dry unit weight.

### 3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
  - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
  - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
  - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade, and compact each layer of backfill or fill soil material at 85 percent.
  - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

## 3.17 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

- 1. Turf or Unpaved Areas: Plus or minus 1 inch.
- 2. Walks: Plus or minus 1/2 inch.
- 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

#### 3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements and walks as follows:
  - 1. Shape base course to required crown elevations and cross-slope grades.
  - 2. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
  - 3. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

#### 3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabson-grade as follows:
  - 1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
  - 2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

#### 3.20 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

- D. Testing Agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
  - 1. Paved and building slab areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sf or less of paved area or building slab, but in no case fewer than three tests.
  - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two tests.
  - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.
- E. With the approval of the Engineer, proof-roll testing of subgrade and/or aggregate base may be substituted for other compaction testing.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

## 3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- D. Weather permitting and as approved, stormwater infiltration facility plants shall be installed as soon as possible after placing and grading the growing media in order to minimize erosion and further compaction.

# 3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Cold milling of existing asphalt pavement.
  - 2. Hot-mix asphalt patching.
  - 3. Hot-mix asphalt paving.
  - 4. Hot-mix asphalt overlay.
  - 5. Pavement-marking paint.
- B. Related Requirements:
  - 1. Section 31 20 00 "Earth Moving" for subgrade preparation, fill material, aggregate subbase and base courses, and aggregate pavement shoulders.

# 1.2 SUBMITTALS

- A. Product Data: For each type of product. Include technical data and tested physical and performance properties.
  - 1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the work.
  - 2. Job-mix Designs: For each job mix proposed for the Work.
- B. Material Certificates: For each paving material.

## 1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Section 0744 of the 2008 Oregon Standard Specifications for Construction for asphalt paving work.
  - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

# 1.4 **PROJECT CONDITIONS**

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expect before time required for adequate cure, or if the following conditions are not met:

- 1. Tack Coat: Minimum surface temperature of 60 degrees F.
- 2. Asphalt Base and Surface Course:

Dense Graded Mixes	Surface Temperature
Less than 2 inches	60 degrees F
2 inches $-2-1/2$ inches	50 degrees F
Greater than 2-1/2 inches	40 degrees F

- 3. If placing asphalt between March 15 and September 30, temperature may be lowered 5 degrees F.
- 4. Do not use field burners or other devices to heat the pavement to the specified minimum temperature.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 degrees F for oil based materials and 55 degrees F for water-based materials, and not exceeding 95 degrees F.

#### PART 2 - PRODUCTS

#### 2.1 AGGREGATES

A. Conform to the requirements of 00744 of the 2008 Oregon Standard Specifications for Construction.

## 2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22.
- B. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt.

#### 2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.
- C. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.
  - 1. Color: Match Existing or as indicated on plans.
- D. Wheel Stops: Precast, air-entrained concrete, 2500-psi (17.2 MPa) minimum compressive strength, 6 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

#### 2.4 MIXES

- A. Recycled Content of Hot-Mix Asphalt: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 10 percent or more than 30 percent by weight.
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
  - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  - 2. Provide mixes conforming to section 00744 of the 2008 Oregon Standard Specifications for Construction.
  - 3. Base Course: Level 2, 1/2-inch dense, HMAC.
  - 4. Surface Course: Level 2, 1/2-inch dense, HMAC.

### PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- B. Proceed with paving only after unsatisfactory conditions have been corrected.

# 3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
  - 1. Mill to a depth of 2 inches.
  - 2. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
- B. If the cold-milled pavement surface will be exposed to traffic, sweep and clean prior to allowing traffic to use the roadway.

#### 3.3 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
  - 1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Apply tack coat uniformly to vertical asphalt surfaces. Apply at a rate of 0.05 to 0.15 gal/sq yd.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
- E. Asphalt and sand seal edges where new asphalt concrete meets existing pavement.

# 3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal/sq yd.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

# 3.5 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
  - 1. Spread mix at a minimum temperature of 250 degrees F.
  - 2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

## 3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
  - 1. Clean contact surfaces and apply tack coat to joints.
  - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
  - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
  - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

# 3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
  - 1. Complete compaction before mix temperature cools to 185 degrees F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
  - 1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

## 3.8 INSTALLATION TOLERANCES

- A. Cold Milling: Test with a 12-foot (3.7-meter) straightedge furnished and operated by the Contractor, as directed. The variation from the top of the ridges from the testing edge of the straightedge, between any two ridge contact points, shall not exceed 1/4 inch.
- B. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  - 1. Base Course: Plus or minus 1/2 inch.
  - 2. Surface Course: Plus 1/4 inch, no minus.
- C. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: 1/4 inch.
  - 2. Surface Course: 1/8 inch.
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.
  - 4. Difference between adjacent panels: 1/8 inch.

### 3.9 PAVEMENT MARKING

- A. Do not apply pavement-marking paint or thermoplastic material until layout, colors and placement have been verified with architect.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
  - 1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

### 3.10 WHEEL STOPS

A. Install wheel stops with dowels.

# 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- B. Replace and compact hot-mix asphalt where core tests were taken.
- C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.
- 3.12 WASTE HANDLING
  - A. Except for material indicated to be recycled, remove excavated materials from Project Site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

# 1.1 SUMMARY

- A. Section Includes:
  - 1. Driveways.
  - 2. Roadways.
  - 3. Parking lots.
  - 4. Curbs and gutters.
  - 5. Sidewalks.

## 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
  - 1. Cementitious materials.
  - 2. Steel reinforcement and reinforcement accessories.
  - 3. Fiber reinforcement
  - 4. Admixtures
  - 5. Curing compounds
  - 6. Applied finish materials.
  - 7. Bonding agent or epoxy adhesive.
  - 8. Joint fillers.
- E. Minutes of pre-installation conference.
- F. Jointing and scoring layout shop drawing.

# 1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing readymixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

- 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
  - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
- C. ACI Publications: Comply with ACI 301 unless otherwise indicated.
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- E. Mockups: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
  - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
  - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  - 3. Obtain Architect's approval of mockups before starting construction.
  - 4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
  - 5. Demolish and remove approved mockups from the site when directed by Architect.
  - 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
  - 1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete producer.
    - d. Concrete pavement subcontractor.

# 1.4 **PROJECT CONDITIONS**

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

# PART 2 - PRODUCTS

#### 2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
  - 1. Use flexible or curved forms for curves with a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

### 2.2 STEEL REINFORCEMENT

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- C. Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.
- D. Tie bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.
  - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
  - 2. For epoxy-coated reinforcement, use epoxy-coated or other dialectric-polymer-coated wire bar supports.

# 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
  - 1. Portland Cement: ASTM C 150, gray Portland Cement Type I or Type II
    - a. Fly Ash: ASTM C 618, Class C.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source.

- 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
- 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 3. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

## 2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz/sq yd dry or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

#### 2.5 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.
- B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements.

# 2.6 DETECTABLE WARNINGS

- A. Detectable warnings: ADA truncated domes aligned in a square or radial grid pattern complying with current ADAAG guidelines. Detectable warnings shall be precast pavers.
  - 1. Color: Red

# CONCRETE PAVING

- 2. Size: Nominal 12 inch x 12 inch.
- 3. Thickness: 2 inch.
- 4. Manufacturers: Tile Tech, Armor Tile, ADA Solutions, or approved equal.

# 2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:
  - 1. Compressive Strength (28 Days): 3500 psi.
  - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
  - 3. Slump Limit: 4 inches, plus or minus 1 inch.
  - 4. Air Content: 5-1/2 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
- B. Use a qualified testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- C. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

### 2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
  - 1. When temperature is between 85 degrees F and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

# PART 3 - EXECUTION

# 3.1 EXAMINATION AND PREPARATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
  - 1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
  - 2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
  - 3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."
- C. Remove loose material from compacted subbase surface immediately before placing concrete.

D. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

## 3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. After the forms have been set to correct grade, the grade shall be thoroughly tamped, either mechanically or by hand, at both the inside and outside edges of the base of the forms. Forms shall be staked into place with no less than 3 pins for each 10-foot section. A pin shall be placed at each side of every joint.
- C. Form sections shall be tightly locked and shall be free from play or movement in any direction. The forms shall not deviate from true line by more than 1/4 inch at any joint. Forms shall be so set that they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment.
- D. The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.
- E. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

### 3.4 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
  - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving

terminates at isolation joints. If sufficient concrete is not available to finish the current panel, the Contractor shall remove the fresh concrete back to the nearest transverse joint.

- 1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
- 2. Provide tie bars at sides of pavement strips where indicated.
- 3. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
- 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint or install plastic dowel sleeves per manufacturer's recommendations.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
  - 1. Locate isolation joints at intervals of 50 feet, unless otherwise indicated.
  - 2. Extend joint fillers full width and depth of joint.
  - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
  - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  - 6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Longitudinal Joints: A longitudinal joint shall be considered a joint parallel with the long dimension of the paving area.
  - Construction: Longitudinal construction joints necessary for lane construction shall be 1. formed against suitable side forms (usually made of steel) with or without keyways, as indicated in the Drawings. Wooden forms may be used under special conditions, when approved by the Engineer. When the concrete is placed using slip-form pavers, the keyway shall be formed in the plastic concrete by means of preformed metal keyway liners which are inserted during the slip-form operations to form the female side of the key and which may be left in place. The dimensions of the keyway forms shall not vary more than plus or minus 1/4 inch from the dimensions indicated and shall not deviate more than plus or minus 1/4 inch from the mid-depth of the pavement. A male keyway may be used providing the keyway and edge tolerances are met. Where butt-type joints with dowels are designated, the dowels for this type shall be painted and greased. The edges of the joint shall be finished with a grooving tool or edging tool, and a space or slot shall be formed along the joint of the dimensions, as indicated, to receive the joint sealing material. Longitudinal construction joints shall be sawed to provide a groove at the top conforming to the details and dimensions indicated on the Drawings. Provisions shall be made for the installation of tie bars as noted on the Drawings.
  - 2. Contraction or Weakened-Plane Type: the longitudinal groove formed or sawed in the top of the slab shall be installed where indicated on the Drawings. The groove shall be

formed in the plastic concrete with suitable tools or material to obtain the width and depth specified, or it shall be sawed with approved equipment in the hardened concrete to the dimensions required. When the groove is formed in plastic concrete, it shall be true to line with not more than 1/4 inch variation in 10 feet; it shall be uniform in width and depth; and the sides of the groove shall be finished even and smooth with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer's instructions. The sawed groove shall be straight and of uniform width and depth. In either case, the groove shall be clean cut so that spalling will be avoided at intersections with transverse joints. Tie bars shall be installed across these joints where indicated on the Drawings.

- E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, to match jointing of existing adjacent concrete paving:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooved marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete once concrete has hardened sufficiently such that the cutting action will not tear, abrade, or otherwise damage the surface and before developing random contraction cracks. The sawing of any joints shall be discontinued or omitted if a crack occurs at or near the joint location before or during sawing. Concrete panels that have started cracking before or during the saw cutting of the joints shall be removed and replaced at no expense to the Owner.
  - 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
- F. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

# 3.5 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

- D. Comply with ACI 301 requirements for measuring, mixing, transporting, placing, and consolidating concrete.
- E. Do not add water to concrete during delivery or at Project site.
- F. Do not add water to fresh concrete after testing.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
  - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
  - 1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.
- I. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- J. Screed paving surface with a straightedge and strike off.
- K. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- M. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
  - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- N. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- O. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

- 1. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F and not more than 80 degrees F at point of placement.
- 2. Do not use frozen materials or materials containing ice or snow.
- 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
- P. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below 90 degrees F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

# 3.6 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
  - 1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
  - 2. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating floatfinished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
- C. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a <sup>1</sup>/<sub>4</sub> inch (6mm) radius. Repeat tooling of edges after applying surface finished. Eliminate tool marks on concrete surfaces.

# 3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sf x h before and during finishing operations.

Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows.
  - 1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

# 3.8 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
  - 1. Elevation: 1/4 inch.
  - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  - 3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed <sup>1</sup>/<sub>4</sub> inch.
  - 4. Joint Spacing: 1/2 inch.
  - 5. Contraction Joint Depth: Plus 1/4 inch, no minus.
  - 6. Joint Width: Plus 1/8 inch, no minus.
  - 7. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
  - 8. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
  - 9. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
  - 10. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.

# 3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain at least 1 composite sample for each 5000 sq. ft. or fraction thereof of each concrete mix placed each day.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
  - 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  - 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 degrees F and below and when 80 degrees F and above, and one test for each composite sample.
  - 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
  - 6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
    - a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressivestrength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

# 3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

# SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

# PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Piping joining materials.
  - 2. Sleeves.
  - 3. Grout.
  - 4. Piping system common requirements.

### 1.2 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

# 1.3 SUBMITTALS

A. Welding certificates.

# 1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

## PART 2 - PRODUCTS

#### 2.1 PIPING 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.
  - 2. AWWA C110, rubber, flat face, 1/8-inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.

### 2.2 SLEEVES

- A. Galvanized Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

- E. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

# 2.3 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

# PART 3 - EXECUTION

#### 3.1 PIPING INSTALLATION

- A. Install piping according to the following requirements and utilities Sections specifying piping systems.
- B. Drawings, 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 the Coordination Drawings.
- C. Install piping to permit valve servicing.
- D. Install piping at indicated slopes.
- E. Install piping free of sags and bends.
- F. Install fittings for changes in direction and branch connections.
- G. Select system components with pressure rating equal to or greater than system operating pressure.
- H. Sleeves are not required for core-drilled holes.
- I. Permanent sleeves are not required for holes formed by removable PE sleeves.

# 3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and utilities. Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

# COMMON WORK RESULTS FOR UTILITIES

- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- I. 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.
- J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.
- K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

- N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End PE Pipe and Fittings: Use butt fusion.
  - 2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

# 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Install dielectric fittings at connections of dissimilar metal pipes.

# 3.4 GROUTING

- A. Clean surfaces that will come into contact with grout.
- B. Provide forms as required for placement of grout.
- C. Avoid air entrapment during placement of grout.
- D. Place grout, completely filling voids and provide smooth surface.
- E. Place grout around anchors.
- F. Cure placed grout.

# END OF SECTION 330500

# SECTION 331100 - WATER UTILITY DISTRIBUTION PIPING

# PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service and fire service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Valves and accessories
  - 2. Water meters and accessories
  - 3. Backflow preventers and assemblies.
  - 4. Fire hydrants.
  - 5. Fire department connections.
  - 6. Pipe.
- B. Field quality control test reports.
- C. Operation and maintenance data for the following:
  - 1. Valves
  - 2. Backflow preventers
  - 3. Hydrants
- D. Shop Drawings: Detail tanks and precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

# 1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing and disinfection.
  - 3. Comply with standards of authorities having jurisdiction for fire-suppression waterservice piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp or other markings of specified testing agency.

# WATER UTILITY DISTRIBUTION PIPING

- C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fireservice-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- F. NSF Compliance:
  - 1. Comply with NSF 14 for plastic potable-water-service piping.
  - 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

### 1.4 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

#### 1.5 COORDINATION

A. Coordinate connection to existing water service with Fern Ridge School District.

# PART 2 - PRODUCTS

#### 2.1 PIPE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
  - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- B. Hard Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L, water tube, drawn temper.
  - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- C. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

- 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
- 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  - 2. Gaskets: AWWA C111, rubber.
- E. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 150 and Class 200]
  - 1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
- F. PVC Schedule 80 Pipe: ASTM D 1785.
  - 1. PVC Schedule 80 Socket Fittings: ASTM D 2467.
  - 2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.
- G. PVC, AWWA Pipe: AWWA C900, Class 150 and Class 200, with bell end with gasket, and with spigot end.
  - 1. Comply with UL 1285 for fire-service mains if indicated.
  - 2. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Gaskets: AWWA C111, rubber.

# 2.2 JOINING MATERIALS

- A. Refer to Section 33 05 00 "Common Work Results for Utilities" for commonly used joining materials.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series.
- C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Soldering Flux: ASTM B 813, water-flushable type.
- E. Solder Filler Metal: ASTM B 32, lead-free type with .20 percent maximum lead content.

# 2.3 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
  - 1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
    - a. Standard: AWWA C219.

# 2.4 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American AVK Co.; Valves & Fittings Div.
    - b. American Cast Iron Pipe Co.; American Flow Control Div.
    - c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
    - d. Crane Co.; Crane Valve Group; Stockham Div.
    - e. East Jordan Iron Works, Inc.
    - f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
    - g. McWane, Inc.; Kennedy Valve Div.
    - h. McWane, Inc.; M & H Valve Company Div.
    - i. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
    - j. Mueller Co.; Water Products Div.
    - k. NIBCO INC.
    - 1. U.S. Pipe and Foundry Company.
  - 2. Nonrising-Stem, Resilient-Seated Gate Valves:
    - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      - 1) Standard: AWWA C509.
      - 2) Minimum Pressure Rating: 200 psig.
      - 3) End Connections: Mechanical joint.
      - 4) Interior Coating: Complying with AWWA C550.
  - 3. Nonrising-Stem, Resilient Wedge Gate Valve:
    - a. Description: ductile iron body bonnet and wedge. The wedge shall be encapsulated in rubber.

- 1) Standard: AWWA C515.
- 2) Minimum pressure rating: 200 psig.
- 3) End Connections: Mechanical joint.
- 4) Interior coating: Complying with AWWA C550.
- 4. OS&Y, Rising Stem, Reduced Wall, Resilient-Seated Gate Valves.
  - a. Description: Ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
    - 1) Standard: AWWA C515.
    - 2) Minimum Pressure Rating: 200 psig.
    - 3) End Connections: Mechanical joint.
    - 4) Interior Coating: Complying with AWWA C550.
- 5. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:
  - a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
    - 1) Standard: AWWA C509.
    - 2) Minimum Pressure Rating: 200 psig.
    - 3) End Connections: Flanged.
- B. UL/FMG, Cast-Iron Gate Valves:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Cast Iron Pipe Co.; American Flow Control Div.
    - b. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
    - c. Crane Co.; Crane Valve Group; Stockham Div.
    - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).McWane, Inc.; Kennedy Valve Div.
    - e. McWane, Inc.; M & H Valve Company Div.
    - f. Mueller Co.; Water Products Div.
    - g. NIBCO INC.
    - h. U.S. Pipe and Foundry Company.
  - 2. UL/FMG, Nonrising-Stem Gate Valves:
    - a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
      - 1) Standards: UL 262 and FMG approved.
      - 2) Minimum Pressure Rating: 175 psig.
      - 3) End Connections: Flanged.
  - 3. OS&Y, Rising-Stem Gate Valves:

- a. Description: Iron body and bonnet and bronze seating material.
  - 1) Standards: UL 262 and FMG approved.
  - 2) Minimum Pressure Rating: 175 psig.
  - 3) End Connections: Flanged.
- C. Bronze Gate Valves:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Crane Co.; Crane Valve Group; Jenkins Valves.
    - c. Crane Co.; Crane Valve Group; Stockham Div.
    - d. Hammond Valve.
    - e. Milwaukee Valve Company.
    - f. NIBCO INC.
    - g. Red-White Valve Corporation.
  - 2. OS&Y, Rising-Stem Gate Valves:
    - a. Description: Bronze body and bonnet and bronze stem.
      - 1) Standards: UL 262 and FMG approved.
      - 2) Minimum Pressure Rating: 175 psig.
      - 3) End Connections: Threaded.
  - 3. Nonrising-Stem Gate Valves:
    - a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
      - 1) Standard: MSS SP-80.

# 2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
    - b. East Jordan Iron Works, Inc.
    - c. Flowserve.
    - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
    - e. McWane, Inc.; Kennedy Valve Div.
    - f. McWane, Inc.; M & H Valve Company Div.

- g. Mueller Co.; Water Products Div.
- h. U.S. Pipe and Foundry Company.
- 2. Description: Sleeve and valve compatible with drilling machine.
  - a. Standard: MSS SP-60.
  - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
  - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
  - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

# 2.6 CORPORATION VALVES AND CURB VALVES

- A. Manufacturers:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Amcast Industrial Corporation; Lee Brass Co.
    - b. Ford Meter Box Company, Inc. (The); Pipe Products Div.
    - c. Jones, James Company.
    - d. Master Meter, Inc.
    - e. McDonald, A. Y. Mfg. Co.
    - f. Mueller Co.; Water Products Div.
    - g. Red Hed Manufacturing & Supply.
- B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
  - 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
  - 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
  - 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

- C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
  - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

# 2.7 FIRE STORAGE TANKS

- A. Description: Fiberglass reinforced plastic underground tank by Xerxes.
  - 1. Riser extensions: Provide riser extensions approved by manufacturer and as shown on plans.

# 2.8 FIRE DEPARTMENT CONNECTIONS

- A. Fire Department Connections:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Elkhart Brass Mfg. Co., Inc.
    - b. Fire End & Croker Corporation.
    - c. Guardian Fire Equipment, Inc.
    - d. Kidde Fire Fighting.
    - e. Potter Roemer.
    - f. Reliable Automatic Sprinkler Co., Inc.
  - 2. Description: Exposed, Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch-high brass sleeve; and round escutcheon plate.
    - a. Standard: UL 405.
    - b. Connections: Two NPS 2-1/2 inlets and one NPS 4 outlet.
    - c. Inlet Alignment: Inline, horizontal.
    - d. Finish Including Sleeve: Rough chrome-plated.
    - e. Escutcheon Plate Marking: "AUTO SPKR & STANDPIPE."
    - f. Exterior Finish: Red or orange OSHA safety colors.

# PART 3 - EXECUTION

#### 3.1 EARTHWORK

A. Refer to Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

## 3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 3/4 to NPS 3 shall be:
  - 1. Soft copper tube, ASTM B 88, Type K or ASTM B 88, Type L; wrought-copper, solderjoint fittings; and brazed joints.
  - 2. PVC, Schedule 80 socket fitting; and solvent-cemented joints.
- F. Underground water-service piping NPS 4 and NPS 12 shall be any of the following:
  - 1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed or mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
  - 2. NPS 4 to NPS 12: PVC, AWWA C900 Class 150 pipe; PVC, AWWA Class 150 ductile iron, mechanical-joint fittings; and gasketed joints.
- G. Underground Fire-Service-Main Piping NPS 4 to NPS 8 shall be any of the following:
  - 1. Ductile-iron, push-on-joint pipe; ductile-iron, mechanical-joint fittings; and gasketed joints.
  - 2. PE, Class 150 or 200, fire-service pipe; molded PE fittings; and heat-fusion joints.
  - 3. PVC, AWWA Class 150 pipe listed for fire-protection service; ductile iron fittings; and gasketed joints.
  - 4. PVC, AWWA Class 200 pipe listed for fire-protection service; ductile iron fittings; and gasketed joints.

### 3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG,

nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient seated gate valves with valve box.
  - 2. Underground Valves, NPS 4 and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
  - 3. Use the following for valves in vaults and aboveground:
    - a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.
    - b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated or UL/FMG, cast iron, OS&Y rising stem.

# 3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Section 33 05 00 "Common Work Results for Utilities" for piping-system common requirements.

# 3.5 PIPING INSTALLATION

- A. Make connections larger than NPS 2 with tapping machine according to the following:
  - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
  - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
  - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
  - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- B. Make connections NPS 2 and smaller with drilling machine according to the following:
  - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
  - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
  - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
  - 4. Install corporation valves into service-saddle assemblies.
  - 5. Install manifold for multiple taps in water main.
  - 6. Install curb valve in water-service piping with head pointing up and with service box.
- C. Comply with NFPA 24 for fire-service-main piping materials and installation.
  - 1. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

- D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- E. Install PE pipe according to ASTM D 2774 and ASTM F 645.
- F. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- G. Bury piping with depth of cover over top at least 36 inches, with top at least 12 inches below level of maximum frost penetration.
- H. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
  - 1. Terminate water-service piping at within 5 feet of building wall until building-waterpiping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, mechanical restraints, and other supports.

#### 3.6 JOINT CONSTRUCTION

- A. See Section 33 05 00 "Common Work Results for Utilities" for basic piping joint construction.
- B. Make pipe joints according to the following:
  - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
  - 2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
  - 3. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
  - 4. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
  - 5. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

# 3.7 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
  - 1. Concrete thrust blocks.
  - 2. Locking mechanical joints.
  - 3. Set-screw mechanical retainer glands.
  - 4. Bolted flanged joints.
  - 5. Heat-fused joints.

- 6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
  - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
  - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
  - 3. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

### 3.8 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- C. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

### 3.9 FIRE STORAGE TANK INSTALLATION

A. Install fire storage tanks according to NFPA requirements and manufacturer's recommendations.

# 3.10 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install protective pipe bollards on two sides of each fire department connection.

#### 3.11 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. See Section 33 05 00 "Common Work Results for Utilities" for piping connections to valves and equipment.
- C. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve or service clamp and corporation valve.
- D. Connect water-distribution piping to interior domestic water and fire-suppression piping.

# 3.12 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
  - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

# 3.13 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
  - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended or repaired before use.
  - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
  - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
    - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

#### END OF SECTION 331100
### SECTION 333100- SANITARY UTILITY SEWERAGE PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes: gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:
  - 1. Pipe and fittings.
  - 2. Nonpressure and pressure couplings.
  - 3. Cleanouts.
  - 4. Backwater valves.

### 1.2 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

# 1.3 SUBMITTALS

- A. Product Data: For the following:
  - 1. Backwater valves
  - 2. Cleanouts
  - 3. Pipe material.
  - 4. Mechanical plugs.
- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping and proximate structures.
- D. Field quality-control reports.

### 1.4 PROJECT CONDITIONS

A. Site information: Research public utility records and verify existing utility locations prior to ordering any materials. Notify the Architect immediately if any discrepancies are found in the project survey.

### PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

#### 2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.
- 2.3 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS
  - A. Pipe: ASTM A 746, for push-on joints.
  - B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
  - C. Compact fittings: AWWA C153, for push-on joints.
  - D. Gaskets: AWWA C11, rubber.

#### 2.4 DUCTILE-IRON, PRESSURE PIPE AND FITTINGS

- A. Push-on-Joint Piping:
  - 1. Pipe: AWWA C151.
  - 2. Standard Fittings: AWWA C110, ductile or gray iron.
  - 3. Compact Fittings: AWWA C153.
  - 4. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings.
- B. Mechanical-Joint Piping:
  - 1. Pipe: AWWA C151, with bolt holes in bell.
  - 2. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell.
  - 3. Compact Fittings: AWWA C153, with bolt holes in bells.
  - 4. Glands: Cast or ductile iron; with bolt holes and high-strength, cast-iron or high-strength, low-alloy steel bolts and nuts.
  - 5. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands.

### 2.5 PVC PIPE AND FITTINGS

- A. PVC Type PSM Sewer Piping:
  - 1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for solvent-cemented or gasketed joints.
  - 2. Fittings: ASTM D 3034, PVC with bell ends.
  - 3. Gaskets: ASTM F 477, elastomeric seals.
- B. PVC Sewer Piping:
  - 1. Pipe: ASTM F679, T-1 or T-2 wall thickness, PVC gravity sewer pipe with bell and spigot ends with integral ASTM F477, elastomeric seals for gasketed joints.

### 2.6 NONPRESSURE-TYPE TRANSITION COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
  - 1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
  - 2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
  - 1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistantmetal tension band and tightening mechanism on each end.
- D. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

# 2.7 EXPANSION JOINTS AND DEFLECTION FITTINGS

- A. Ductile-Iron, Flexible Expansion Joints:
  - 1. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.
- B. Ductile-Iron Expansion Joints:
  - 1. Description: Three-piece assembly of telescoping sleeve with gaskets and restrainedtype, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or

AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated.

- C. Ductile-Iron Deflection Fittings:
  - 1. Description: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for up to 15 degrees of deflection.

### 2.8 CLEANOUTS

- A. Cleanouts: At-grade cleanouts shall have an adjustable sleeve-type housing, a threaded brass plug with counter sunk slot, and cast iron frame and cover.
- B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fittings and riser to cleanout.

#### 2.9 CONCRETE

- A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R, and the following:
  - 1. Cement: ASTM C 150, Type II.
  - 2. Fine Aggregate: ASTM C 33, sand.
  - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
  - 4. Water: Potable.
- B. Portland Cement Design Mix: 3000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
  - 1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
  - 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.
- C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
  - 1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
  - 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

# 2.10 BACKWATER VALVES

- A. PVC Backwater Valve: PVC Body with extendable riser pipe.
  - 1. Available Manufacturers:
    - a. Clean Check.
    - b. Rector Seal.
    - c. Mainline.
    - d. Approved equal

## PART 3 - EXECUTION

#### 3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 20 00 "Earth Moving."

### 3.2 PIPING APPLICATIONS

- A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
  - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
    - a. Unshielded or shielded flexible couplings for same or minor difference OD pipes.
    - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
- B. Gravity-flow, Nonpressure Sewer Piping: Use any of the following pipe materials for each size range.
  - 1. NPS 4 to NPS 15: PVC sewer pipe and fittings gaskets, and gasketed joints.

#### 3.3 PIPING INSTALLATION

- A. Install tracer wire directly over piping and at outside edges of underground structures. See Section 31 20 00 "Earth Moving" for tracer wire material requirements.
- B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- F. Install gravity-flow, nonpressure, sewer piping according to the following:

- 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
- 2. Install piping with 36-inch minimum cover.
- 3. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
- G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.
- H. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- I. Install backwater valves in piping where indicated.

### 3.4 PIPE JOINT CONSTRUCTION

- A. Basic piping joint construction is specified in Section 33 05 00 "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, nonpressure, drainage piping according to the following:
  - 1. Join PVC corrugated sewer piping according to ASTM D 2321.
  - 2. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
  - 3. Join dissimilar pipe materials with nonpressure-type, flexible [or rigid] couplings.
  - 4. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
- C. Join force-main, pressure piping according to the following:
  - 1. Join ductile-iron pressure piping according to AWWA C600 or AWWA M41 for push-on joints.
  - 2. Join ductile-iron special fittings according to AWWA C600 or AWWA M41 for push-on joints.
  - 3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
  - 4. Join PVC service piping according to ASTM D 2855.
  - 5. Join dissimilar pipe materials with pressure-type couplings.
- D. Pipe couplings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
  - 1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
    - a. Unshielded flexible couplings for pipes of same or slightly different OD.
    - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

### 3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

### 3.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use pipe fittings in sewer pipes at branches for cleanouts, and use PVC pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
  - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
  - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
  - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
  - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, per the Detail. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

### 3.7 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drain. Use transition fitting to join dissimilar piping materials.
- B. Connect force-main piping to building's sanitary force mains specified in Section 221316 "Sanitary Waste and Vent Piping." Terminate piping where indicated.
- C. Make connections to existing piping and underground manholes.
  - 1. Use commercially manufactured wye fittings for 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.
  - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
  - 3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by core drilling into existing unit. Make connection into existing pipe using an "Inserta-Tee" fitting per the manufacturer's recommendations or approved equal. Make connection to existing manhole using round rubber gasket installed on the pipe per the manufacturer's instructions. Cut end of connection pipe passing through the manhole wall to conform to the shape of and be flush with the inside wall unless otherwise indicated. The opening around the gasket shall be grouted to a watertight seal. Existing manhole inverts, flow lines, channels, etc. shall be chipped out and re-grouted to accommodate the new pipe.

- a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
- b. Use epoxy-bonding compound as interface between new and existing concrete, and piping materials.
- 4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- D. Make connections to existing piping and underground structures so finished Work complies with requirements specified for new Work.

### 3.8 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate report for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Damage: Crushed, broken, cracked or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  - 1. Do not enclose, cover, or put into service before inspection and approval.
  - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
  - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  - 4. Submit separate report for each test.
  - 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
    - a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
    - b. Allowable leakage is maximum of 50 gal/inch of nominal pipe size per mile of pipe, during 24-hour period.
    - c. Close openings in system and fill with water.
    - d. Purge air and refill with water.

- e. Disconnect water supply.
- f. Test and inspect joints for leaks.
- g. Option: Test concrete gravity sewer piping according to ASTM C 924.
- 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
  - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

### 3.9 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

## END OF SECTION 333100